NICOLET INSTRUMENT CORPORATION
OSCILLOSCOPE DIVISION

INSTRUCTION MANUAL

FOR

SERIES 2090

EXPLORER DIGITAL OSCILLOSCOPE

DECEMBER, 1979

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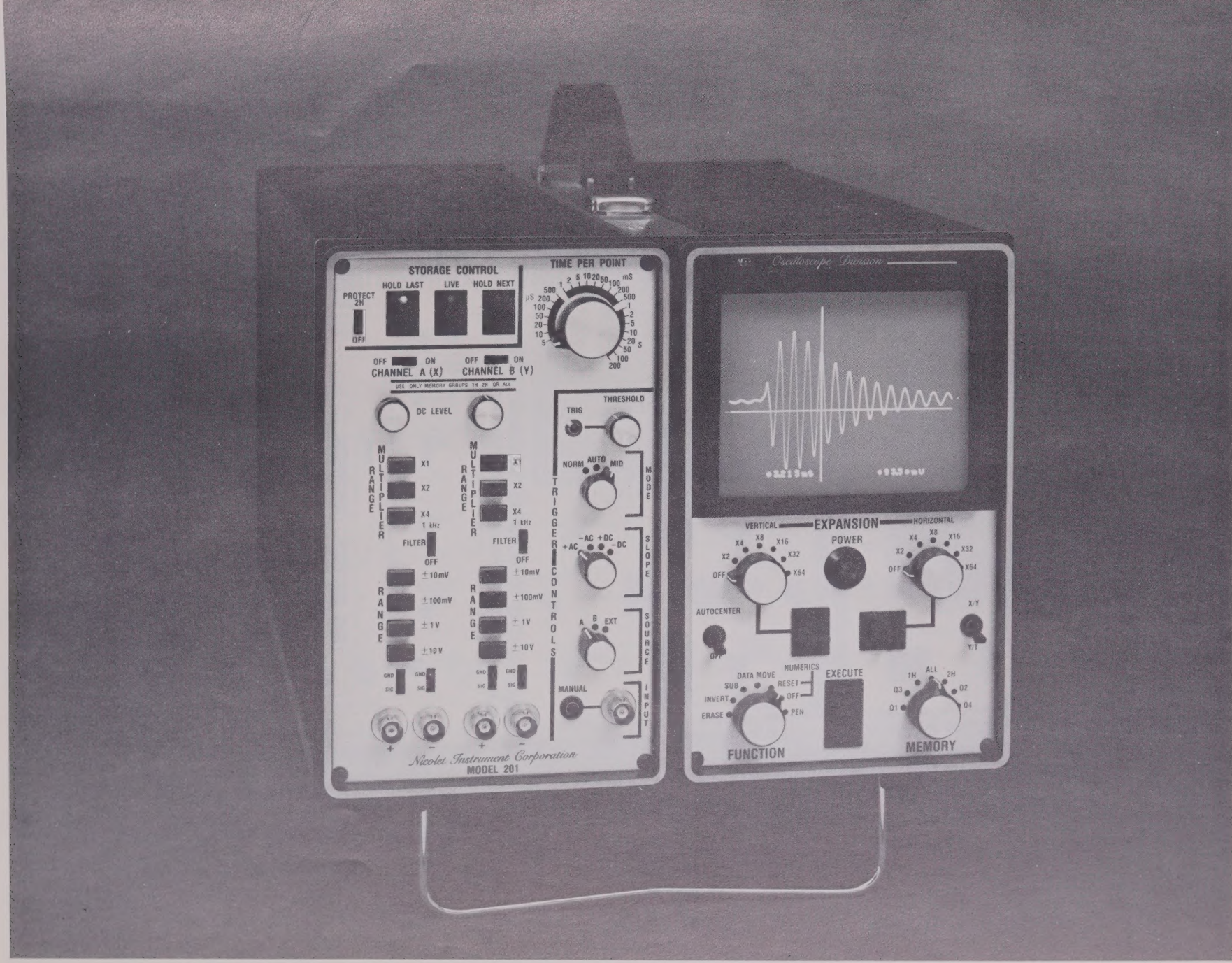
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X4
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MODE
−AC +AC +DC −DC
SLOPE
A B EXT
SOURCE
MANUAL
INPUT
Nicolet Instrument Corporation
MODEL 201
Oscilloscope Division
EXPANSION
VERTICAL
HORIZONTAL
POWER
X2 X4 X8 X16 X32 X64
OFF
AUTOCENTER
X/Y
Y/T
DATA MOVE
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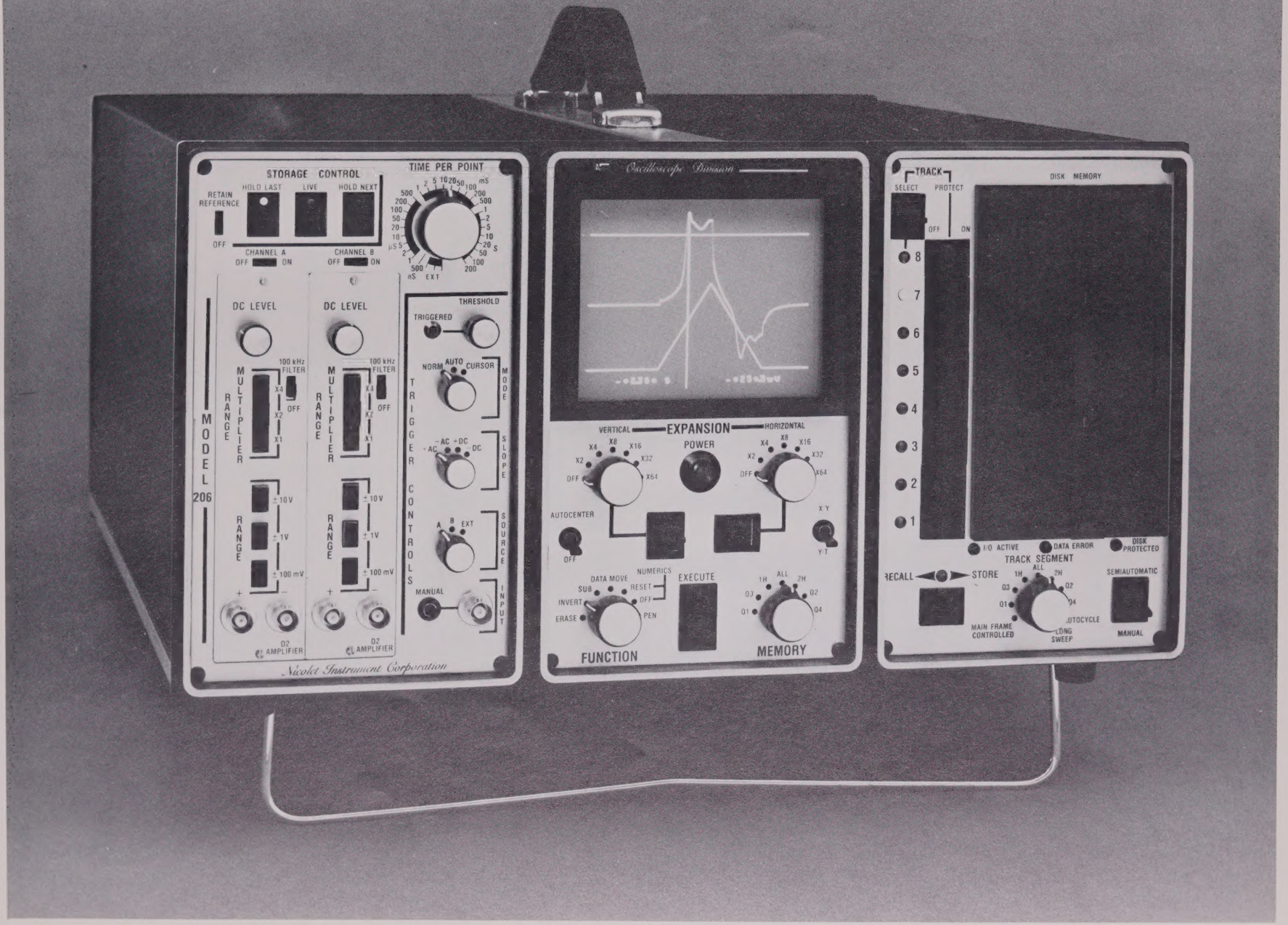
PEN
EXECUTE
FUNCTION
1H ALL 2H
Q1 Q2 Q3 Q4
MEMORY


STORAGE CONTROL
RETAIN REFERENCE
OFF
HOLD LAST
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CHANNEL A
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CHANNEL B
OFF ON
TIME PER POINT
DC LEVEL
DC LEVEL
MULTIPLIER
RANGE
100 kHz FILTER
OFF
X4
X2
X1
±10 V
±1 V
±100 mV
D2 AMPLIFIER
MODEL 206
THRESHOLD
TRIGGERED
NORM
AUTO
CURSOR
MODE
SLOPE
SOURCE
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Nicolet Instrument Corporation
Oscilloscope Division
VERTICAL
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I/O ACTIVE
DATA ERROR
DISK PROTECTED
TRACK SEGMENT
RECALL
STORE
SEMIAUTOMATIC
MAIN FRAME CONTROLLED
LONG SWEEP
MANUAL

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I. INTRODUCTION

This portion of the EXPLORER Series Instruction Manual describes the general design and operating characteristics of the EXPLORER II and III Oscilloscopes, as well as the recommended operating procedures. These should be understood by the operator, in order to make full use of the numerous new benefits provided by these instruments. For the most part, operation is conventional, but the nature of the instrument, which is a digital oscilloscope, is such that there are a number of new techniques involved in the operation.

Typically, an experienced analog oscilloscope operator can learn the operating procedures even without consulting this instruction manual. It is nevertheless recommended that this manual be utilized rather than depending upon trial-and-error learning.

II. GENERAL DESIGN

The block diagram of the EXPLORER Series is shown in simplified form in Figure 1. For the case in which a plug-in unit such as Model 206 is in use, the signal information is converted to digital form, stored in a buffer memory, then transferred to the main frame memory for display purposes, the microprocessor controlling the beam of the display cathode-ray tube.

Details of plug-in unit and microprocessor structure and programming are beyond the scope of this discussion, but certain characteristics are of interest and help in understanding the instrument.

In this manual the term "sweep" is used in a manner analogous to its use in analog oscilloscopes. When a sweep trigger signal is received, the analog-to-digital converter measures the signal at intervals (separated by amounts which depend upon the selected sweep speed) and transfers the information to the buffer memory. Depending upon front panel switch settings, when 1024, 2048, or 4096 measurements have been made, the sweep ends. The information is then transferred from the buffer memory to the main frame memory and the oscilloscope is ready to receive another sweep trigger. In the case of slow sweeps (10 μsec per point or longer) the information is transferred during rather than after each sweep.

The microprocessor continually interrogates the main frame memory and produces the waveform display as well as marker lines (cursors) and numerics.

This is a simplified description of operations. The sequences differ under different conditions, for example, where two signal

channels are in use or where "cursor triggering" is in use. The operations described, however, are representative of the manner in which the oscilloscope handles the signal information.

The method differs radically from that used in an analog oscilloscope, which controls the display tube directly from the amplified signal voltages and a sawtooth "sweep" voltage. While in simple, undemanding oscilloscope applications, the operation and appearance of the display are almost indistinguishable from those of analog oscilloscopes, there are fundamental advantages gained.

Descriptions of the controls of the EXPLORER Series, and of specific kinds of measurement given in this manual disclose the usefulness of most of the advantages. To make the best use of these improvements, Section III should be read and understood.

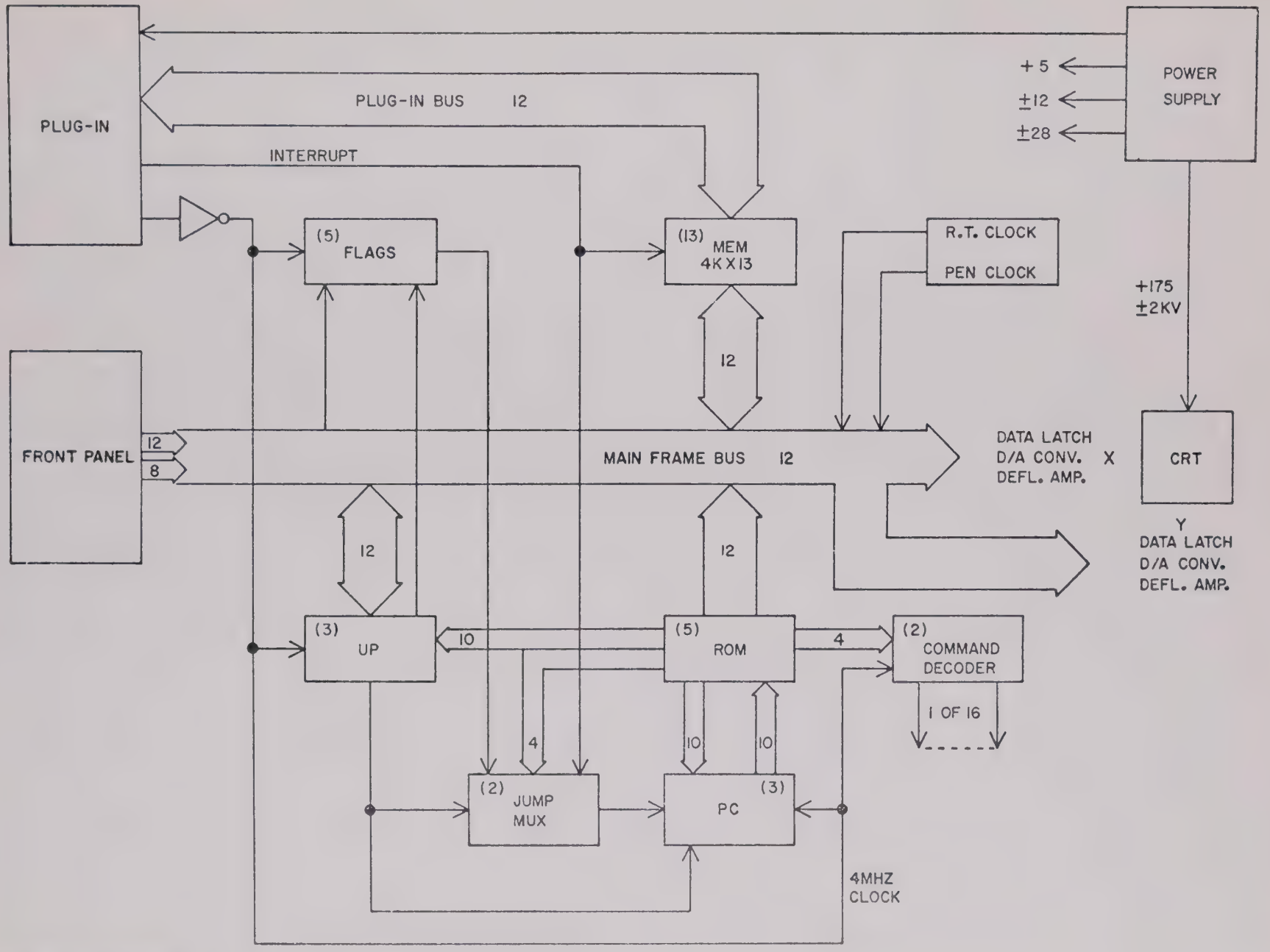


FIGURE 1

BLOCK DIAGRAM

III. INITIAL INSTALLATION

A. Power Requirements

This instrument operates from any one of four AC power source voltages: 101, 115, 202, and 230 volts AC, all ±10%. The power lines frequency allowable is 50-60 Hz ±5%. These must be single phase power sources with neutral wire at or near ground potential, a separate safety ground at ground potential, and the third wire the line wire. See Figure 2 for the position of the neutral, line, and safety terminals at the connector.

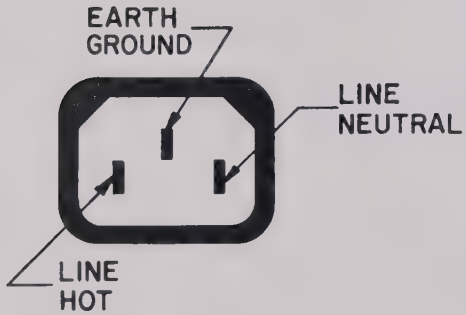


Figure 2

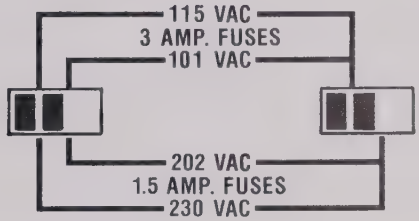


Figure 3

Switches at the rear of the cabinet allow selection of the range. Figure 3 indicates the switch positions which should be used for each of the four voltage ranges. The table below may be used for this purpose also.

Input Voltage Range	Left Switch	Right Switch
101 ±10%	Right Position	Left Position
115 ±10%	Left Position	Left Position
202 ±10%	Right Position	Right Position
230 ±10%	Left Position	Right Position

The fuses used must be 3 ampere slow blow fuses if the input power is either 101 or 115 volts ±10%, and must be 1.5 ampere slow blow fuses for the 202 and 230 volt ±10% ranges.

It is imperative that the switches be in the correct positions for the power line voltage that will be involved, to avoid serious damage to the oscilloscope circuits. Inspect the switches for correctness of settings when the instrument is received. If the switches are changed, double check the correctness of their new settings before applying power.

The power requirement for this instrument is nominally 225 volt amperes. It is higher in the case of operation with some plug-in units than others. It should never require more than 300 volt amperes, average, under worst case conditions.

B. Environment

This instrument may be operated at air temperatures of from 0°C to 33°C. To operate from 0°C to 45°C, reduce the incoming AC voltage 9% from the nominal input. Storage may be at -55°C to +70°C

C. Thermal Cut-Out

In the event of excessive temperature, power is shut off automatically, and will be restored after the temperature returns to a safe level. This cutoff is slow acting, and will not protect against overheating due to high storage temperatures followed by operation before the chassis has cooled, internally, to near the recommended operating environmental temperature.

IV. OPERATING PROCEDURES

A. "First Time" Procedures

When operating this instrument for the first time, unfamiliarity with the controls will cause a certain amount of difficulty, as with any new instrument of comparable complexity. Use an hour or two to learn the behavior of the instrument. First read this section, then after a few minutes of experimenting, you should take the time to read the remainder of Section IV. It is assumed that the Initial Installation section has been read.

In initial experimenting, to start some "action", place the trigger mode switch to the AUTO position. The sweeps will then occur even in the absence of triggering signals.

Be sure that the TIME PER POINT switch setting is reasonable; if it is in a very slow speed setting, it could be hours before a sweep is completed, and you could conclude that there is a malfunction because whatever you might do with the other controls, you may not see a signal waveform. Use a 1 μsec/point sweep speed setting initially.

Apply a signal, preferably of a few volts amplitude, and experiment just as you would with any new oscilloscope. If you have a two channel plug-in unit, be sure that the channel to which you have applied the signal has been switched "on", and that the other channel is "off".

B. Main Frame Operating Controls

1. Horizontal Display Controls

The EXPANSION switch allows you to select a scale multiplier factor from 1 to 64. The expansion is digitally accomplished and therefore exact.

It is important for you to know that the functions invert, subtract, and data move discussed below, will not take place unless the HORIZONTAL EXPANSION switch is in the OFF position. Erase will work with HORIZONTAL EXPANSION turned on, but only the displayed portion of the waveform will be erased.

When expansion occurs, it occurs symmetrically about the vertical marker line, which you can position left or right by use of the paddle switch below the HORIZONTAL EXPANSION switch.

You will notice when in an unexpanded display mode, that the marker when moved will move at a rate of about a centimeter/second. This corresponds to up to 400 data points per second. You will not be able to position it easily at an exact location because of reaction time. You can move it one data point at a time, however, by just momentarily operating the switch. If you hold the switch left or right for over 0.6 seconds, the marker will then proceed at 400 data points/second.

You will also notice that the rate of movement slows, if you have selected an expanded view. This allows "finer" control; using an expansion factor of 16, the marker moves at a rate of approximately 16 points/sec., so you can react quickly enough to control the movement.

Placement of the horizontal position control to the right will cause the waveform to move right during expanded view operation. It will cause the cursor to move to the right when an unexpanded display is in use.

2. Vertical Display Controls

The VERTICAL EXPANSION switch, when "on", expands the display vertically. The expansion is symmetrical about the horizontal marker line. This line may be moved up or down by means of the paddle switch below the VERTICAL EXPANSION switch. That positioning switch isn't used often, for you can instead use the AUTOCENTER feature, which causes that line to be positioned so that it is at the same level as that of the data point intersected by the vertical marker line. This, in expanded views, automatically causes the waveform to pass through screen center. The numerics indicate the voltage and time coordinates for that center point, so you do not lose baseline information, when the autocenter mode is in use. If it is not in use, the numerics indicate the coordinates of the waveform point intersected by the vertical marker line.

3. The MEMORY Selector Switch

The main frame memory can be used in its entirety (4096 addresses), or in groups of 1024 or 2048. You may place a waveform in the 2048 point section referred to as H1, then switch to H2 for observation of live waveforms or for storing another waveform. Later you can switch back to section H1 to examine the waveform you stored earlier. Similarly, section Q1, consisting of 1024 points, may be used to store a waveform, and you can use Q2, Q3 and Q4 for others.

Never switch to a new memory section while in the "Live" mode. Doing so will usually result in that stored waveform being replaced by new signal information.

4. The XY Selector Switch

When this switch is on, two waveforms in memory (or "Live" waveforms) will be displayed as functions of each other. A waveform recorded in Q1 (X) will be plotted as a function of one in Q3 (Y), when the Memory Selector switch is placed in the H1 position. Similarly, waveforms in Q2 (x) and Q4 (Y) will be plotted as functions of each other when the switch is in the H2 position. A waveform recorded in H1 (X) will be plotted vs one in H2 (Y), if the Memory Group Selector switch is in the "All" position.

If the plug-in unit is a two channel unit, the two "Live" signals will be plotted in this way regardless of what memory section is in use.

In the XY mode, placing the AUTOCENTER switch to AUTOCENTER will cause the A vs B function to pass through screen center. In expanded views, use of the Horizontal Position control causes the trace to "move" through that center position so that different points will be centered. The numerics displayed refer to that centered point. The selected point, in unexpanded or noncentered displays, is marked for identification.

You can alter the selection of which point is marked only by using the autocenter mode and the Horizontal Position switch, whether or not expanded display is used.

5. The FUNCTION Switch

This switch provides for pen recording and simple manipulations of information stored in memory. If the function involves alteration of stored data, the HORIZONTAL EXPANSION switch must be set to OFF. All functions are done by pressing the EXECUTE button.

a. ERASE

This is used rarely. It has been included in order to clear "junk" from the screen prior to use of a long sweep, to make it easier to watch the waveform unfold as the sweep progresses. A cleared memory is also useful in the process of adjusting the "zero" position of a pen recorder.

b. INVERT

This causes the voltage values of the waveform stored in memory to be multipled by -1, when the Execute button is depressed.

c. SUBTRACT

When this function is executed, corresponding points of two waveforms are subtracted from each other. Which two this will be depends on the memory switch setting:

If the switch is set at Q1, the waveform in Q1 will be subtracted from that in Q3 and the difference will be placed in Q1.

If the switch is set at Q3 the difference (Q1 - Q3) will be placed in Q3.

If the switch is set at Q2, the difference (Q4 - Q2) will be placed in Q2.

For the setting Q4,(Q2 - Q4) will be placed in Q4.

For a setting H1, (H2 - H1) will be placed in H1.

For a setting H2, (H1 - H2) will be placed in H2.

For the ALL setting there will be no change in the waveforms as this would not be a valid operation.

The original waveform may be recovered by repeating the subtraction step that produced the difference signal.

Difference measurements traditionally have been made by using a differential amplifier. With this oscilloscope they also can be made using just one signal probe, by recording first one waveform, then the other, and subtracting. There is then an assurance that there will be essentially no amplifier DC or AC imbalance, since only one signal channel and attenuator circuit is involved. It also is mechanically easier to do this than to connect two probes. There are, of course, situations in which this is not an allowable procedure, for example, when common mode voltages are present and vary with time.

If it is desired to add two signals, the "subtrahend" of the subtraction operation should first be inverted and then the subtraction process executed.

d. DATA MOVE

When this operation is performed the waveform is vertically repositioned so that the "selected point" intersected by the vertical marker line is raised or lowered so that it appears at the same level as the horizontal marker line, and all other waveform points are shifted by a like amount. This causes loss of base-line information, if this is of importance, make a note of the original voltage level for a selected point. Then the waveform can be "data-moved" back to its original level later.

e. RESET NUMERICS

This operation causes the origin to be changed. Instead of the normal origin of t_0=trigger time and v_0=zero volts, pressing the EXECUTE button causes the origin to change to the present position of the cursor line intersection.

Note that if the AUTOCENTER switch is ON, the horizontal marker line will be at the intersection of the vertical marker, and the waveform. Thus, the new origin is changed to the intersection of the vertical (time) line and the waveform.

To restore the numbers to absolute values, with respect to the time zero, voltage zero "original" origin, turn the FUNCTION switch to some other position. Returning

that switch to the RESET NUMERICS position again causes the numerics to be relative to the new origin. This operation can be applied only to stored waveforms, not during "Live" operation. It is not necessary to press EXECUTE.

f. NUMERICS OFF

This is self-explanatory.

g. PEN

Pen recorder drive signals are provided at BNC connectors on the rear of the cabinet. These are designed to operate into high impedance pen recorder circuits (50,000 ohms or higher), and have a range of nominally 0 to 5 volts full scale for both X and Y drives. The pen recorder should have a manually operable pen lift, and it must be an XY recorder rather than a strip chart recorder. It should have a pen slew speed capable of full scale deflection in ten seconds or less.

The readout rate is automatically controlled to take into account the pen slew times; instead of reading data out at a rate of one second per point, it reads it out at a rate which is very high in featureless regions, but slow whenever substantial pen excursions are involved. The basic readout rate can be adjusted by the rear panel pen speed control. This decreases or increases the rate to adapt to very slow recorders or to faster recorders.

Before the pen readout is executed, the pen drive voltages are approximately zero. This corresponds to a vertical negative full scale position on the paper, and the leftmost part of the waveform.

To calibrate the recorder, place a full scale DC level into the oscilloscope. This is done by placing the plug-in in Live, using one channel without an input, and Auto trigger. Turn the channel's DC offset adjust until the offset is at full scale. Now place the plug-in in Hold Last. Initiate a pen recording. The pen recorder will draw a box corresponding to the horizontal and vertical limits of the pen outputs. Adjust the inputs of the pen recorder until the outline is drawn as required. After calibration has been achieved, this box may be drawn for each pen recording so that the horizontal and vertical limits of a recording can be shown with each tracing of a signal.

If the oscilloscope display expansion controls are in use, so that only part of a waveform is being shown, that same part will be recorded in the pen recording operation. You may "compose" the recording, by adjusting the display controls. The recording does not include drawing of the marker lines or numerics shown on the cathode ray tube screen.

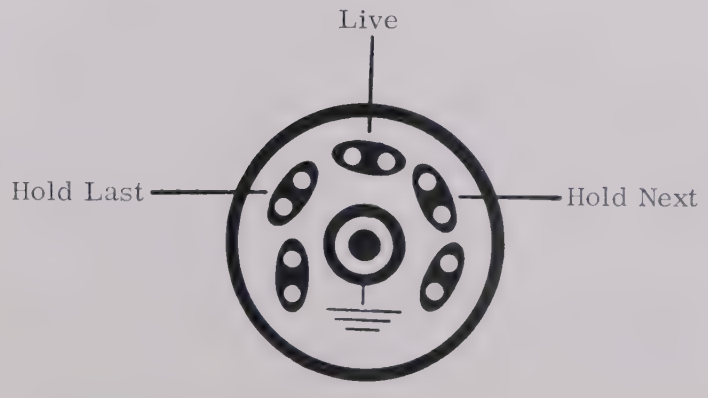
It is best not to attempt to record superimposed waveforms, except by first recording one, then the other. The pen, otherwise, will alternate vertically between one waveform and the next for each point, which is undesirable both because of appearance and because of greatly increased recording time.

6. REMOTE CONTROL Connector

The functions of the two hold pushbuttons and the LIVE pushbutton can be achieved by use of signal inputs provided on the rear panel REMOTE CONTROL connector.

Remote control requires that external commands be generated. The signal needed is an open circuit (or open transistor collector) for no action, with a ground potential applied to cause the action. Remote control can be used in order to take advantage of the high speed of a remote sensor, rather than relying on your reaction time. It can also be used in order to allow you to manually control storage from a location away from the oscilloscope front panel (e.g., a probe pushbutton can be used).

Refer to the following diagram for pin connection details.



C. Model 206 Plug-In Operating Controls

1. The Storage Controls

The LIVE pushbutton, when depressed momentarily, allows the instrument to respond to both signal input and trigger input as selected. A valid trigger will cause new information to replace the old.

The HOLD NEXT pushbutton allows one more sweep, only to be triggered, after it is depressed when operation is "Live".

The HOLD LAST pushbutton, when momentarily depressed, allows no further triggering but if a sweep is already in progress, it allows that sweep to be completed.

The RETAIN REFERENCE switch, when "on", prevents new signal information from being entered into alternate memory locations; half the data points then indicate the "Live" ongoing signal waveforms and half represent the older waveform being protected. The effect is to allow waveforms to be compared closely, one of the waveforms being stored, the other "Live".

When operating in the "Cursor Trigger" mode (See Section IV, C.5.b.2) the change to or from the RETAIN REFERENCE mode takes place at the end of a sweep, if the plug-in is kept in Live. Whenever the LIVE button is depressed, the RETAIN REFERENCE mode, either on or off, is entered into the 206 control logic. In other triggering modes, altering the switch position causes this mode to take effect at the beginning of the next sweep and therefore, the protection is effective more immediately.

2. The TIME PER POINT Control

This switch allows selection of sweep speed of 500 ns per point and exact multiples (2, 5, 10 etc.,) of 1 μs, up to 200 seconds per point. You should not change the position of this switch during long sweeps, if you do not wish information to be lost, in part.

3. CHANNEL ON-OFF Switches

The Model 206 plug-in unit can be used as a single channel unit if the unused channel is switched off. Switching off both channels is physically possible, but an incorrect operation. If this is done, the instrument may appear to operate correctly with certain settings of the MEMORY switch and trigger source, but with other settings of these switches the instrument will not operate correctly. Therefore, be sure to have one channel "on".

If you wish to examine only one signal source, you will be using only one amplifier; the other signal channel should be switched off. Even when it is switched off, you may use the second signal amplifier to receive a trigger signal from another source, rather than using the EXTERNAL trigger signal input.

4. TRIGGER THRESHOLD and TRIGGER SLOPE

When the trigger signal voltage crosses the threshold level selected by this control, a sweep is triggered if the oscilloscope is in the "Live" mode. It is a positive transition which causes the sweep to start if the TRIGGER SLOPE switch is in the "AC+ or DC" position" otherwise it is the negative transition.

In the case of positive transition triggering, the trigger signal voltage must recross back below the threshold after the trigger has occurred and must drop below that threshold voltage by an appreciable amount, before another trigger can occur. This requirement is to prevent infinite sensitivity. The same is true for negative transition triggering, but in the opposite direction.

The amount by which the trigger signal must continue beyond the threshold during the recrossing after a trigger has occurred determines the sensitivity. The sensitivity is nominally 0.5 volts for external triggering. It is nominally one tenth of the full scale range selected, for internal triggering.

The AC coupling time constant is 0.1 seconds. The external trigger circuit input impedance is 1 Megohm. The external trigger voltage should not exceed $\pm$25 volts.

5. Trigger Controls

a. TRIGGER SOURCE Selection

The 206 plug-in allows sweep triggering to be initiated by either an externally provided signal, or from the signals from the amplifier of either channel A or B. When internal triggering is in use, for example by means of the signal from the channel A amplifier, the A channel is usually "on" (See Section IV, C.3), and the signal is displayed on the screen. If channel B is also "on", two waveforms are displayed, those applied to each of the two amplifiers.

If channel A is switched "off", the signals applied to it continue to cause triggering, and in this situation the "B" waveform continues to be displayed if the "A" signal continues to provide suitable trigger signals.

This is conventional in modern analog oscilloscopes, also. The purpose in using one channel for triggering, even if its waveform is not displayed, is to allow the signal being used for triggering to be "conditioned", i.e., amplified, attenuated, level shifted, or filtered, by the amplifier. It also allows you to "see" the signal if you temporarily switch that plug-in unit channel "on", thereby allowing you to confirm that what is causing the triggering is really what you want to cause it; and that the trigger threshold is set at a safe level above noise and also safely below the maximum point of the triggering signal feature.

The 206 plug-in unit also provides for manual push-button triggering, which is used when no trigger signal feature is present, such as at the beginning of a long measurement of some variable such as room temperature.

b. The NORM-AUTO-CURSOR TRIGGER MODE CONTROL

1. NORMAL and AUTOMATIC Triggering (206)

Normally, triggering is produced in a conventional manner. The AUTO trigger mode is one in which another sweep is caused to occur automatically, if no trigger occurs within 22 milliseconds after the preceding sweep is ended. The automatic triggering is used principally during set-up procedures.

2. The CURSOR TRIGGER MODE

Cursor triggering is the mode which allows observation of signal regions both preceding and following the trigger time. How much pre-trigger information, and how much post-trigger information will be shown is determined by the position of the vertical marker line (the cursor) displayed on the screen when an unexpected display is in use.

It is ordinarily just as easy to use this mode of triggering as the NORMAL mode. There is one situation which should be kept in mind, however. During the use of very slow sweeps it will be observed that information is not transferred to the main frame for display until the sweep is completed. You might sometimes observe by means of the TRIGGERED led on the panel that a trigger has occurred, yet nothing seems to be happening. You may even suppose that there has been a malfunction, especially if the sweep is very long in duration. It is not a malfunction; when the sweep ends the signal waveform will be displayed.

The CURSOR TRIGGER mode is sometimes referred to as the "mid-signal trigger" mode. It is made possible by recording into the plug-in unit memory continuously, but not transferring that information to the main memory for display until some time after the trigger signal is received. The buffer memory contains past history, therefore, that will be used to indicate the signal waveform that corresponds to the signal that existed before the trigger. In the period before the trigger, the buffer may become "full", after which the oldest information is discarded to make room for the most recent. Usually that buffer contains 4096 data "points", therefore.

When a trigger occurs, this process is allowed to continue for a time, the length of time depending upon the position of the vertical marker line, the cursor. At the end of that time, the contents are transferred to the main memory. The "pre-trigger-time" information is therefore displayed, followed by the "post-trigger" information. The act of transferring information to the main memory consumes typically 2 milliseconds, and for practical design reasons, all information is discarded from the buffer, at that time. This means that the next trigger cannot be allowed to happen until the buffer again contains a sufficient amount of "new" history. If it occurs too soon, it will be ignored by the oscilloscope.

This is an important consideration in the case of very slow sweeps. Suppose, for example, that you want to observe what precedes an event that you expect might happen during the night. You may then select a sweep time of 11.5 hours (10 seconds per point if you are using the full memory and a single input channel). If you need to see what happened before the event, an hour of information for example, you will set the cursor to a position about a tenth of the way from the left of the screen. There must be at least one hour of running before a trigger will then be accepted. You must place the instrument in the CURSOR trigger mode, and press the LIVE pushbutton at least an hour before the event is expected in this case.

6. The DC LEVEL Control

This should normally be set to a position which causes the trace to be at the zero voltage position when the signal probe is removed from any signal source. The numerical voltage value displayed indicates trace level. When measurements require high accuracy, this setting should be checked with appropriate care. DC level drifts of as much as 0.025% of full scale per hour, even at constant temperature, can be expected except in the case of drift-stabilized plug-in units. Furthermore, amplifier gain switch selection changes can introduce DC level offset changes of as much as 0.1% of full scale.

7. External Sweep Timing Control

The Model 206 plug-in unit includes the capability of allowing external control of sweep timing, in place of the internal crystal oscillator control. This feature is referred to as the "External Address Advance" capability.

This capability is provided when the TIME PER POINT switch is placed in one of the three positions counterclockwise from the 500 ns position.

The Model 206 plug-in provides three external timing modes:

MODE 1: This is referred to as the "fast, non-synchronous" mode. In this, the first externally provided timing pulse acts as a sweep trigger pulse and as the first "sample" command.

The following pulses each act as "sample" commands, and when they occur the signal is measured and recorded within 650 ns, until the "sweep" is concluded following 1024, 2048, or 4096 such commands, depending upon the size of the memory group being utilized.

The pulses are applied to the INPUT BNC connector, and it is necessary to use the NORMAL triggering mode, and the EXTERNAL SOURCE triggering mode should be used. The trigger threshold level control, and the polarity and AC/DC coupling controls are used in a normal manner, and control the response to these externally applied pulses.

Use the first position counterclockwise from the 500 ns position, for this mode.

Note that there is limited synchronization of timing. There will be a delay of from 150 to 650 ns following each applied pulse before the signal is actually measured.

In this mode, the timing pulses must not occur with a spacing less than 500 ns.

MODE 2: The Model 206 provides a second external timing mode, with 400 ns delay and 25 ns timing uncertainty, but in which the minimum pulse spacing allowed is 1.5 μsec. The second time base switch position counterclockwise from the 500 ns position is used for this mode.

MODE 3: The third unmarked position counterclockwise, of the Model 206 time base switch, provides a slow, synchronized mode. Minimum external timing pulse spacing is 4 μsec, and time of measurement delay of 400 ns and 25 ns timing uncertainty. Unlike MODE 1 and MODE 2, this mode allows the waveform of the signal being measured to be observed during the sweep rather than afterwards.

NOTE: On units shipped before September 1, 1978, MODE 2, under certain circumstances does not operate correctly. If MODE 2 is required, please consult Nicolet in Madison, Wisconsin. Also, MODE 3 is nonsynchronized on units shipped before September 1, 1978.

D. Model 204-A Plug-In Unit Operation

General

This 20 MHz sampling rate plug-in unit is operated in substantially the same manner as other EXPLORER plug-in units. It is an 8-bit-resolution plug-in unit, rather than 12 bits, and as a consequence you should not need to utilize very high vertical display expansion when viewing waveforms. A x4 vertical expansion, you will find, is about the maximum effective expansion, beyond which the information becomes less, rather than more, meaningful. Experiment with the expansion control, to confirm this.

1. Controlling Storage

Causing the oscilloscope to store a signal is an easy matter; you only need to touch one of the two HOLD pushbuttons to cause either the next or the last preceding signal to be stored.

There are some simple choices to make concerning what part of the memory you will use for storage. The choice depends on what other signals you want to store, if any, and upon whether or not you will want to continue to use the oscilloscope while the stored signal or signals are being held.

The memory may be divided into quarters or halves or you may use the entire memory. Obviously, for a given sweep speed, the more memory you use the longer the signal segment that will be stored, but the fewer the number of signals that you can store. Your measurement situation will determine your choice.

After storage, you may superimpose the stored signal waveforms, or view them singly. To view stored signals superimposed on line signal waveforms, you must use the RETAIN REFERENCE switches. Each of the four switches "freezes" certain coordinate points. Every fourth point starting at the first point is protected against change when the left switch is in the "up" position. The next switch is used to protect every fourth point starting with the second. The next switches protect the 3rd and 4th points, respectively, and every fourth point following.

You can easily test the effects of these switches by using them while watching live signals being displayed. Note how easy it is to accurately compare signal waveforms presently occurring with one or more earlier signals.

2. Remote Storage Control

At the rear of the cabinet is a REMOTE connector, with contacts which allow you to duplicate the functions of the HOLD and LIVE pushbutton switches from a remote location. See Section IV-11 which indicates the contact arrangement. The signals required are contact closures or open-collector TTL logic circuit output signals.

3. Time Per Point (Sweep Speed) Control

The sweep speed selector is calibrated in terms of time units per point rather than time per centimeter. This is because if display expansion is is use, the "per centimeter" term becomes incorrect.

For single channel operation, you should turn off the ınel Selector Switch for the unused channel. The signal lifier is not turned off by this switch, so you may use ıt channel for a trigger signal source even though the gnal to that channel is not being displayed or stored.

Trigger LEVEL, COUPLING, SLOPE and SOURCE Controls

The trigger signal transition across a selected voltage ıevel produces an oscilloscope sweep. The trigger LEVEL control is used to select the threshold level. The SLOPE switch determines whether the transition must be from below or from above the threshold. The SOURCE and COUPLING switches are traditional in function.

When the selected trigger signal has crossed the selected threshold voltage, of course it must re-cross it in the return direction in order that it may again cross it in the selected direction to start the next sweep. The voltage must re-cross past the threshold by a considerable amount, before the trigger circuits again become armed.

This means that very small signals cannot cause triggering. While the signal voltages may cross the selected threshold voltage, and may return back over the threshold, the return may not be far enough to re-arm the trigger circuits. The amount by which the signal voltages must return past the threshold is nominally ten percent of the full scale range in use, for internal triggering, and 0.5 volts if external triggering is in use.

6. Triggering Modes

The AUTO-NORMAL pushbutton switch allows you to operate with or without a trigger source. When in the "out" position a triggering signal from Channel A or B, or the signal applied to the external trigger signal BNC connector, is needed. When in the "in" position, another sweep will occur automatically within 29 milliseconds of the end of the preceding sweep, or if a trigger signal is received before that time.

The CURSOR trigger mode, sometimes called midsignal trigger mode, is one in which the sweep seemingly begins before the trigger signal is received. This seems impossible, at first thought, but is made easy by means of a digital signal delay line. The signal delay, insofar as the display is concerned, has the same effect as if the sweep trigger had been advanced. Thus, the sweep appears to have started before the trigger signal occurred.

The amount of signal delay, in the case of this plug-in unit, is adjustable by moving the vertical marker line on the screen, called the "cursor". To adjust the delay, switch off the horizontal expansion, and position the cursor at the location you wish to correspond to time zero, the time of trigger occurrence. Press the CURSOR LOCK button so that future changes in cursor position won't affect the location of time zero.

7. The DC Offset Control

This should normally be set to a position which causes the trace to be at the zero voltage position when the signal

probe is removed from any signal source. The numerical voltage value displayed indicates trace level. When measurements require high accuracy, this setting should be checked with appropriate care. DC level drifts of as much as 0.1% of full scale per hour, even at constant temperature, can be expected. Furthermore, amplifier gain switch selection changes can introduce DC level offset changes of as much as 1% of full scale.

8. Slow Sweeps

During the use of very slow sweeps it will be observed that information is not transferred to the main frame for display until the sweep is completed. You might sometimes observe by means of the TRIGGERED light on the panel that a trigger has occurred. yet nothing seems to be happening. This is not a malfunction; when the sweep ends the signal waveform will be displayed.

9. External Sweep Timing Control

The Model 204-A plug-in unit includes the capability of allowing external control of sweep timing, in place of the internal crystal oscillator control. This feature is referred to as the "External Address Advance" capability.

This capability is provided when the TIME PER POINT switch is placed in any of the three marked positions. All positions operate the same.

The External Address Advance mode is initiated, after the TIME PER POINT switch is moved to the correct position, by a trigger signal. Normally the trigger signal is received through the External Trigger input, but either of the two channels can be used as a trigger. The first trigger pulse acts as a normal sweep trigger and as a "sample" command.

The following pulses each act as "sample" commands, and when they occur the signal is measured and recorded within 100 to 150 nanoseconds with External trigger.

The timing pulses must not occur with a spacing less than 100 ns.

When using the External Address Advance, as when using normal sweep timing, the signal cannot be seen until all needed timing pulses are received.

E. Model 201-2 Plug-In Operating Controls

1. General

This plug-in unit is designed for low frequency measurements, and provides appropriate sensitivity, input impedances, and stability for the majority of such measurements.

In most respects, the operating procedures involved are the same as for the Model 206 plug-in unit, described earlier beginning on Page IV-12.

2. The Amplifier

The plug-in unit utilizes a stable, low noise, low input bias current instrumentation amplifier in each channel. This amplifier has an input impedance of nominally 10^{11} Ω differential and 10^{13} Ω common mode (each input, to ground). The input currents are nominally ±2 pa, each input, doubling each 10° C. (See paragraph E9, Page 38, for test techniques.)

For the +10 volt sensitivity range, an attenuator is switched into the input circuits, which changes the input impedance to 10^6 Ω from the + and the - inputs to ground.

Because of the high impedance "floating" inputs, this amplifier must have one input grounded (or tied to a suitable dc reference if the signal voltage is not near ground potential), when operating "single ended". The unused input must be grounded or suitably biased, except for the ±10, 20, and 40 volt ranges.

Because of the sensitivity and high impedances, reasonable care in shielding should be used in connecting the signal source to the oscilloscope.

Electrostatic and electromagnetic fields, which do not affect other oscilloscopes noticeably, can significantly affect the signals in the case of this oscilloscope. What you see on the screen is what is present between the input terminals; appropriate shielding is needed to insure that only the signal of interest is present.

3. The Storage Controls

The LIVE pushbutton, when depressed momentarily, allows the instrument to respond to both signal input and trigger input as selected. A valid trigger will cause new information to replace the old.

The HOLD NEXT pushbutton allows one more sweep, only, to be triggered, after it is depressed when operation is "live".

The HOLD LAST pushbutton, when momentarily depressed, allows no further triggering but if a sweep is already in progress, it allows that sweep to be completed.

The RETAIN REFERENCE switch, when "on" prevents new signal information from being entered into alternate memory locations; half the data points indicate the "live" ongoing signal waveforms when these are occurring and half represent the older waveform being protected. The effect is to allow waveforms to be compared closely, one of the waveforms being stored, the other "live".

When the retain reference mode is in use, it is always the odd-numbered memory addresses which are protected. These correspond to the "second half" of the memory (H2). When the entire memory is being used, odd numbered points are being protected.

When memory section H1 is in use, none of the data points are protected. When using section H2, all are protected. Thus, there will be a superposition of stored and live waveforms only when using the ALL position of the MEMORY selector switch.

NOTE: The Model 201-2 plug-in should not be operated while using the Q1, Q2, Q3, Q4 positions of the MEMORY selector switch. It is "illegal" to use those positions, except when the oscilloscope is in the "Hold" condition. The oscilloscope will refuse to accept data if that switch is in the wrong position.

4. The TIME PER POINT Control

This switch allows selection of sweep speeds of 5 μs per point and multiples (10, 20, 50 etc.), up to 200 seconds per point. You should not change the position of this switch during long sweeps, if you do not wish information to be lost in part. However, if you wish to end a very long sweep quickly, you may, if you first press the HOLD LAST pushbutton.

5. Channel On-Off Switches

The plug-in unit can be used as a single channel unit if the unused channel is switched off. Switching off both channels is physically possible, but an incorrect operation.

If you wish to examine only one signal source, you will be using only one amplifier; the other signal channel should be switched off. Even when it is switched off, you may use the second signal amplifier to receive a trigger signal from another source, rather than using the EXTERNAL trigger signal input. It is only the digital data which is blocked; the amplified signal may be used for internal triggering when desired.

6. Trigger Threshold and Trigger Signal Coupling

When the trigger signal voltage crosses the threshold level selected by this control, a sweep is triggered if the oscilloscope is in the "Live" mode. It is a positive transition which causes the sweep to start if the Trigger Signal Coupling switch is in the AC+ or DC+ position otherwise it is the negative transition.

In the case of positive transition triggering, the trigger signal voltage must recross back below the threshold after the trigger has occurred and must drop below that threshold voltage by an appreciable amount, before another trigger can occur. This requirment is to prevent infinite sensitivity. The same is true for negative transition triggering, but in the opposite direction.

The amount by which the trigger signal must continue beyond the threshold during the recrossing after a trigger has occurred determines the sensitivity. The sensitivity is nominally 0.5 volts for external triggering. It is nominally one tenth of the full scale range selected, for internal triggering.

The AC coupling time constant is 0.1 seconds. The external trigger circuit input impedance is 1 Megohm. The external trigger voltage should not exceed $\pm$25 volts.

7. Trigger Selection

a. Trigger Source Selection

The 201 plug-in allows sweep triggering to be initiated by either an externally provided signal, or from the signals from the amplifier of either channel A or B. When internal triggering is in use, for example by means of the signal from the channel A amplifier, the A channel is usually "on" and the signal is displayed on the screen. If channel B is also "on", two waveforms are displayed, those applied to each of the two amplifiers.

If channel A is switched "off", the signals applied to it continue to cause triggering, and in this situation the "B" waveform continues to be displayed if the "A" signal continues to provide suitable trigger signals.

The purpose in using one channel for triggering, even if its waveform is not displayed, is to allow the signal being used for triggering to be "conditioned", i.e., amplified, attenuated, level shifted, or filtered, by the amplifier. It also allows you to "see" the signal if you temporarily switch that plug-in unit channel "on", thereby allowing you to confirm that what is causing the triggering is really what you want to cause it; and that the trigger threshold is set at a safe level above noise and also safely below the maximum point of the triggering signal feature.

The plug-in also provides a choice of direct external triggering, and it also provides for manual pushbutton triggering for use when no trigger signal feature is present, such as at the beginning of a long measurement of some variable such as room temperature, which is not associated with a "start" event.

b. The NORM-AUTO-MID TRIGGER Control

(1). Normal and Automatic Triggering

Normally, triggering is produced in a conventional manner, a sweep beginning within 250 nanoseconds after the trigger has occurred. The AUTO trigger mode is one in which sweeps recur one after another, automatically, even with no trigger signal applied. The automatic triggering is used principally during set-up procedures.

(2) The Mid-Signal Trigger Mode.

In order to observe segments of the signal corresponding to times preceding the trigger signal occurrence, it is necessary to delay the signal information in some way. This "shifts" the position of the waveform to the right from its ordinary position, when viewed on the screen.

The signal is continuously digitized by the plug-in unit, in the "live" mode, and entered into a digital "delay line", using one fourth of the main frame memory as that "delay line". At the moment the trigger signal occurs, that memory section contains one fourth of one "sweep's worth" of signal information.

It is placed in that memory address sequentially, but of course there is no way of knowing at what address the last data point will be entered prior to the trigger occurrence. The data will be automatically rearranged so that the oldest information is in the first address, the latest in the 1024th address, after the trigger occurs. The plug-in unit circuits cause that rearrangement, while post-trigger information continues to be entered in other memory sections. At the end of the sweep, 1024 points of data corresponding to pre-trigger signal information and 3072 points corresponding to post-trigger information have been entered in memory.

If you have depressed the appropriate Hold push-button, the 4096 point waveform is steadily displayed, after the sweep has ended. If you haven't, and operation remains "live", the "delay line" part of the memory immediately begins to receive new signal information. You can see what is being entered by watching the right hand one fourth of the "waveform".

8. XY Operation

The left hand, or "A" channel should be used to receive the "X" variable, for it will determine horizontal position, while the "B" input provides vertical position, for each coordinate point.

The high input impedances make the plug-in especially easy to use for measuring characteristics of solid state devices, for

example the input voltage-current characteristics of a transistor where sub-nanoampere currents may be of interest. To measure current, a large resistor (e.g., 10^7 ohms) may be placed between a voltage source, such as a triangular wave generator, and the transistor base (or gate). One channel (channel B, usually) is used to measure the voltage across the resistor. The other channel is used to measure base (or gate) voltage. In this case, the sweep speed should roughly match the triangular wave frequency so that a little more than one cycle occurs per sweep. Use the YT display mode to verify this relationship. It is not harmful to use several cycles per sweep, but if a pen recording is to be made of the data, the pen will "trace" an essentially continuous line, if only one or two cycles of the independent variable have been used. Otherwise it may "jump" from one part of the voltage-current characteristic to another and greatly slow the speed of recording.

Furthermore, since the circuit impedances may be high, the variables may have to be changed slowly, to allow stray capacitances to charge to steady state values. Using several cycles per sweep is unnecessary and may greatly slow the measurement.

The numerics on the screen show the XY values for any selected point. The left number corresponds to the "X" value received from signal channel A, the left channel. The right hand number shows the ordinate, or Y value, received via channel B.

9. Input Bias Current Tests

If a capacitor of about 0.01 μf is connected, with leads as short as possible; from one input to ground, and if the other amplifier input grounded, the bias currents present can be measured by noting the drift in voltage across the capacitor according to the relationship:

$$(1) \qquad i = C \frac{\Delta e}{\Delta t}$$

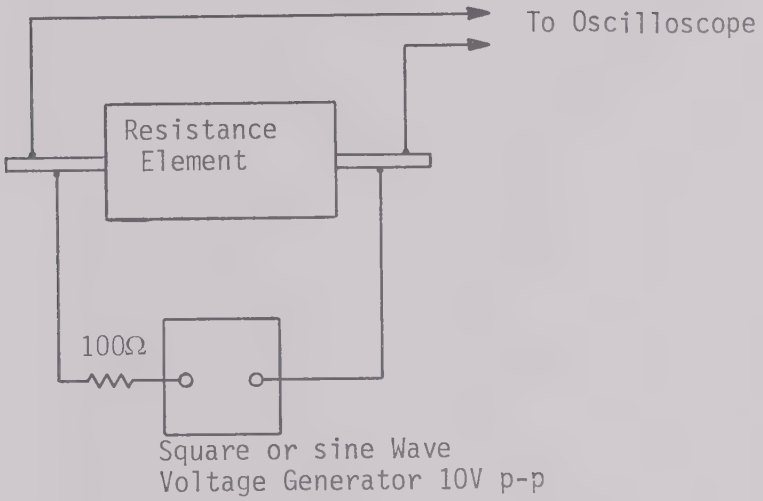
Where i is the bias current, $C = 0.01 \times 10^{-6}$, Δe is the observed voltage change for some convenient time interval Δt.

Use a slow sweep, such as 50 milliseconds per point, start the sweep, then short circuit the capacitor for a few seconds. A bias current of 1 pa will be indicated if the voltage changes at a rate of a millivolt in ten seconds. The capacitor should not be touched by the hands for a few minutes prior to the test because temperature changes can introduce various e.m.f. generating effects, and it may be necessary to keep the capacitor shorted for a few minutes in advance to eliminate "memory" of earlier charges.

This test also discloses the nature of input current "noise" (or random variations with time). It indicates the limits of error involved when very high signal source impedances are involved. With practice, valid tests can be made in two or three minutes, and it is worthwhile making such tests regularly (perhaps once a week) if signal currents are expected to be a nanoampere or so, full scale.

10. Resistance Measurements

Very low resistances, such as contact resistances, printed circuit leads, etc., can be measured by applying a square wave of current through the resistive element. The voltage resulting may be measured, to determine the voltage/current ratio, hence the resistance.



This set-up makes resistance measurements independent of the resistances of the various connections used. For example, the clip leads from the current source may be as high as 100 milliohms without affecting the results by more than 0.1%. It is also independent of thermal e.m.f.'s, since those have dc effects, the a.c. peak-to-peak voltage noted across the element is used in determining the resistance, not a d.c. voltage. The resistance, R, is given by:

$$R = \frac{\Delta E_{pp}}{\Delta I_{pp}}$$

Where ΔI_{pp} is in this case 0.1A. Resolution of 1% is provided, using this simple set-up, for resistance values as low as 5 milliohms, when using the most sensitive range of the model 201 plug-in, and as little as 50 micro-ohms can be sensed.

If a slow sweep is used, resistance changes as a function of parameters such as temperature may be observed.

V. SOME OPERATING TECHNIQUES AND SPECIAL FUNCTIONS

A. The Numeric Display

The numbers shown on the photo of Figure 4 correspond to the waveform point intersected by the vertical marker line. That line may be moved to any desired location. In XY display, the numbers correspond to the voltage-voltage coordinate of the brightened point. To move the brightened point, switch to AUTOCENTER and use the horizontal position control. The left number corresponds to ordinate value, the right to abscissa, in XY display.

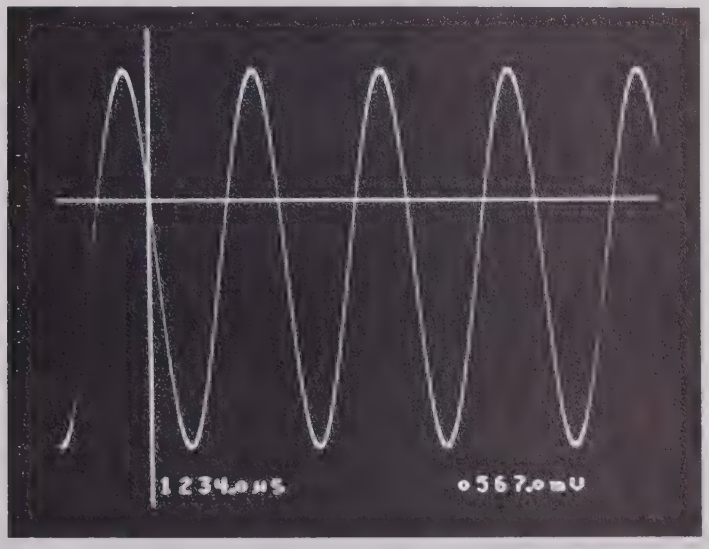


Figure 4

In all cases, normalization of values is according to the control settings used when the signal was measured, whether or not the controls have since been altered.

The voltage values do not take into account DC level control settings. The DC offset voltage produced by that control appear as a component of the signal. For this reason, it is usually preferrable to adjust that offset so that with the signal probe removed from the signal source, the voltage value shown is zero (during "Live" operation and with the sweep triggered continuously).

B. Numerical Display Use When Multiple Waveforms Are Displayed

The numerics indicate the time and voltage corresponding to the intersection of the vertical marker line and the waveform, if one signal trace, only, is involved. There will be two or four such intersections if waveforms are being displayed superimposed. Which of the waveforms corresponds to the numerical information can easily be observed by switching to AUTOCENTER for then the horizontal marker line intersects the vertical marker line at the data point associated with the numerical values shown.

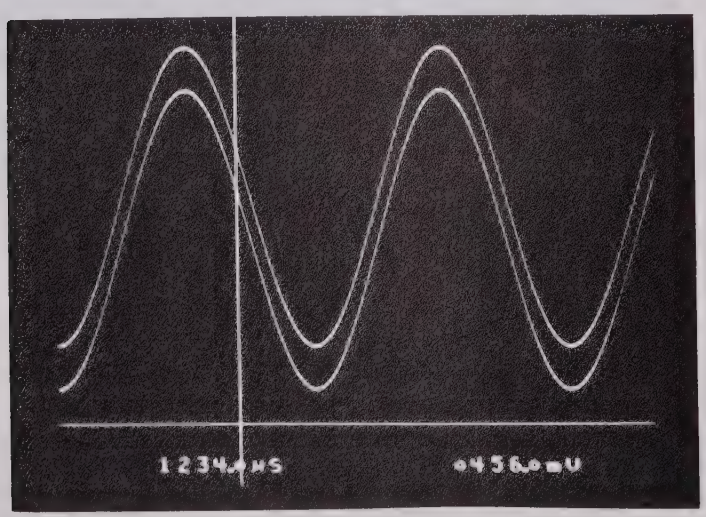


Figure 5
When autocenter is not used, there is no simple indication of which of the two waveforms shown here corresponds to the numerical voltage and time display.

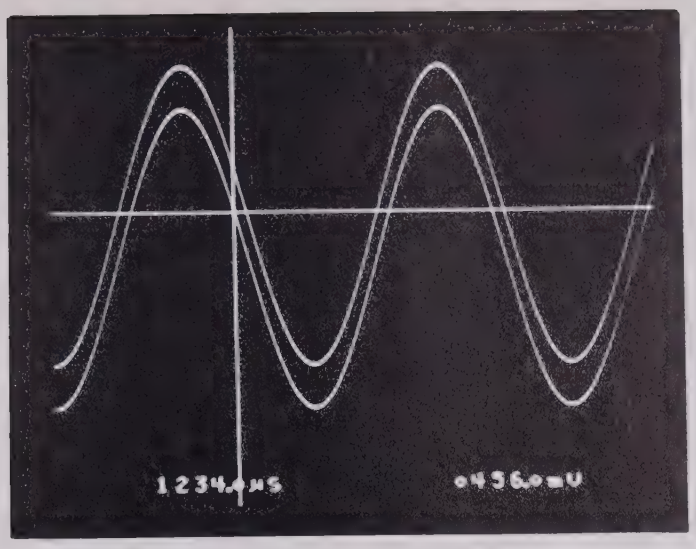


Figure 6
When autocenter is used, the horizontal and vertical marker intersection is at the data point corresponding to the numerical values shown.

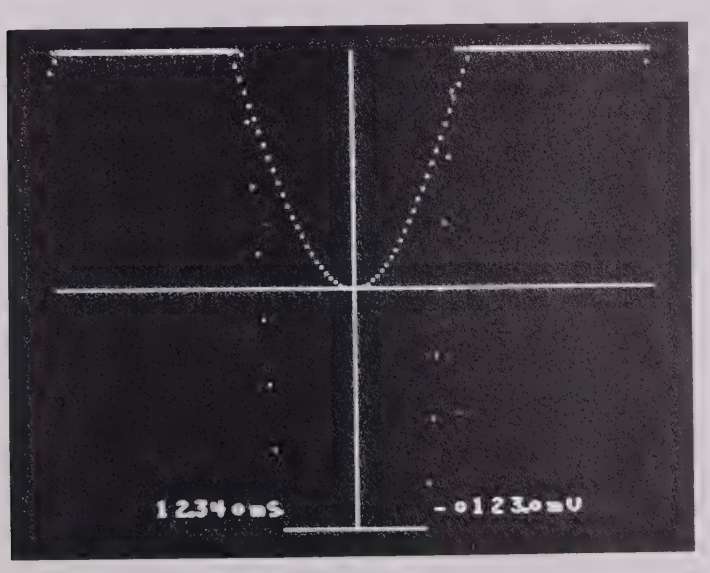


Figure 7
When multiple waveforms are shown superimposed, with display expansion and autocenter in use, the intersection of the two marker lines is at screen center, and the numerics correspond to the data point at the intersection.

C. Very Low Speed Sweeps

Operation, when long sweeps are involved, is the same as otherwise. An indirect effect occurs, however. There is no instant visual "feedback" to you that indicates that your set-up procedures were correct. If the measurement is an overnight measurement, you may discover in the morning that you had used the wrong amplifier gain, or the wrong memory size, or some such thing. Because such a mistake can be costly, it is best to use certain advance precautions.

1. Make the same measurement, in practice, using a moderate sweep speed, for example, a total sweep time of about 20 seconds. This faster rate is slow enough to let you see the consequences of an error, such as failure to depress the HOLD LAST pushbutton after the sweep is triggered, or failure to switch the correct signal channel "on", or other errors.

2. Be careful in selecting the correct sweep speed. A one second per point sweep speed results in roughly one hour total sweep duration when the ALL position of the MEMORY switch is in use, and one signal channel is being used. For an overnight measurement, therefore, you should then use a 20 second per point sweep speed. This will give a 23 hour long measurement.

Remember that if two signal channels are in use, each trace will contain only 2048 points. A 20 second per point sweep will last 11.5 hours.

3. In some cases, you may wish to prematurely end the sweep. The measurement may have proceeded from five o'clock p.m. for example, and 15 hours later at eight a.m. you may have returned and do not want to wait eight more hours for the sweep to end.

The correct way to end the sweep is to depress the HOLD LAST pushbutton, and keep it depressed, then touch the LIVE pushbutton. The data are then preserved properly. This action must result in the green "Live" light being "off". If it isn't, repeat the premature-stop procedure.

It is tempting instead to merely switch to a faster sweep speed, which also will end the sweep as rapidly as you wish, but there are two possible bad effects in doing that. One is that the oscilloscope may enter the wrong normalizing constant into its memory, so the numerical display will show incorrect times for the data. Another is that unless you had been careful to depress the HOLD LAST pushbutton another sweep might occur, and all of the signal information obtained during the night will be erased by this possible spurious sweep.

Practice ending rather long sweeps prematurely the correct way to ensure that the procedure, as you follow it, produces the desired effect.

As a precaution, switch the trigger selector to EXT, and remove all inputs to the External Trigger BNC connector, when using very long sweeps. This is simply

to assure that in the event you do forget to depress the HOLD LAST pushbutton after the sweep begins, another sweep will not begin when the first one ends. Start very long sweeps by using the MANUAL Trigger pushbutton, only, as a precaution.

4. After taking all of the above precautions, erase the "junk" contents of the memory, just so you can more easily see the signal of interest as it "unfolds" on the screen. Then start the sweep in the usual manner by touching the "Live" pushbutton, the MANUAL trigger pushbutton, then the HOLD LAST pushbutton.

If you have done all of these things, you should be able to leave. It is reassuring, however, to take a look, using high display magnification, at the first data points. Every 20 seconds, if that's the sweep time in use, a new point should be plotted. Seeing these tells you that a sweep has really started, that you have in fact selected the desired sweep speed, and that some sort of signal is present of reasonable appearance. Take a last look at the HOLD LAST pushbutton red light, to be sure it is "on", and leave.

NOTE: It is a characteristic of this instrument that numeric normalizing information is not transferred to the main frame microprocessor until late during a sweep, in "Live" operation. This is of no practical consequence except during the use of very low sweep speeds. During those sweeps the numerics will initially be normalized incorrectly;

if the TIMER PER POINT or voltage range switches have been changed since the previous sweep, the numerics will be in error by an indefinite amount, until the sweep has progressed to at least memory address.

This is an inconvenience only rarely. If it is of importance to have meaningful numbers during the long sweep, however, a helpful procedure is to set the controls first, as desired for the long sweep. Then switch to a sweep speed 1000 times faster and trigger one sweep. Then return to the required slow sweep speed, and when ready, start the sweep. The numerics will be correct, except the alphabetical time multiplier (ms, s) will be indicated as 1000 times less than it should, an easy thing to keep in mind, and hardly likely to be misinterpreted. Later in the sweep, the correct normalizing will be transferred, so the alphabetical character will be correct.

If this procedure is not followed, none of the numerical or alphabetical information will be predictable, for either voltage or time, during as much as five eights of the long sweep.

D. Capturing Single Events

When the HOLD NEXT pushbutton is depressed, following your pressing of the LIVE pushbutton, one sweep, only, will occur. A single signal can be captured in this way.

If the single signal you wish to capture is of special interest or value, some advance precautions should be taken, to avoid a mistake. It is, of course, entirely a function of how rare or valuable the signal information is, that determines how much care you use. If the information is both rare and valuable, you should:

1. Confirm the safety margins in the trigger sensitivity setting by advance practice runs.

2. Confirm proper amplifier, sweep speed selections, and other oscilloscope and external apparatus adjustments by practice runs.

3. Never fail to depress the HOLD NEXT pushbutton after switching to LIVE operation for the final measurement.

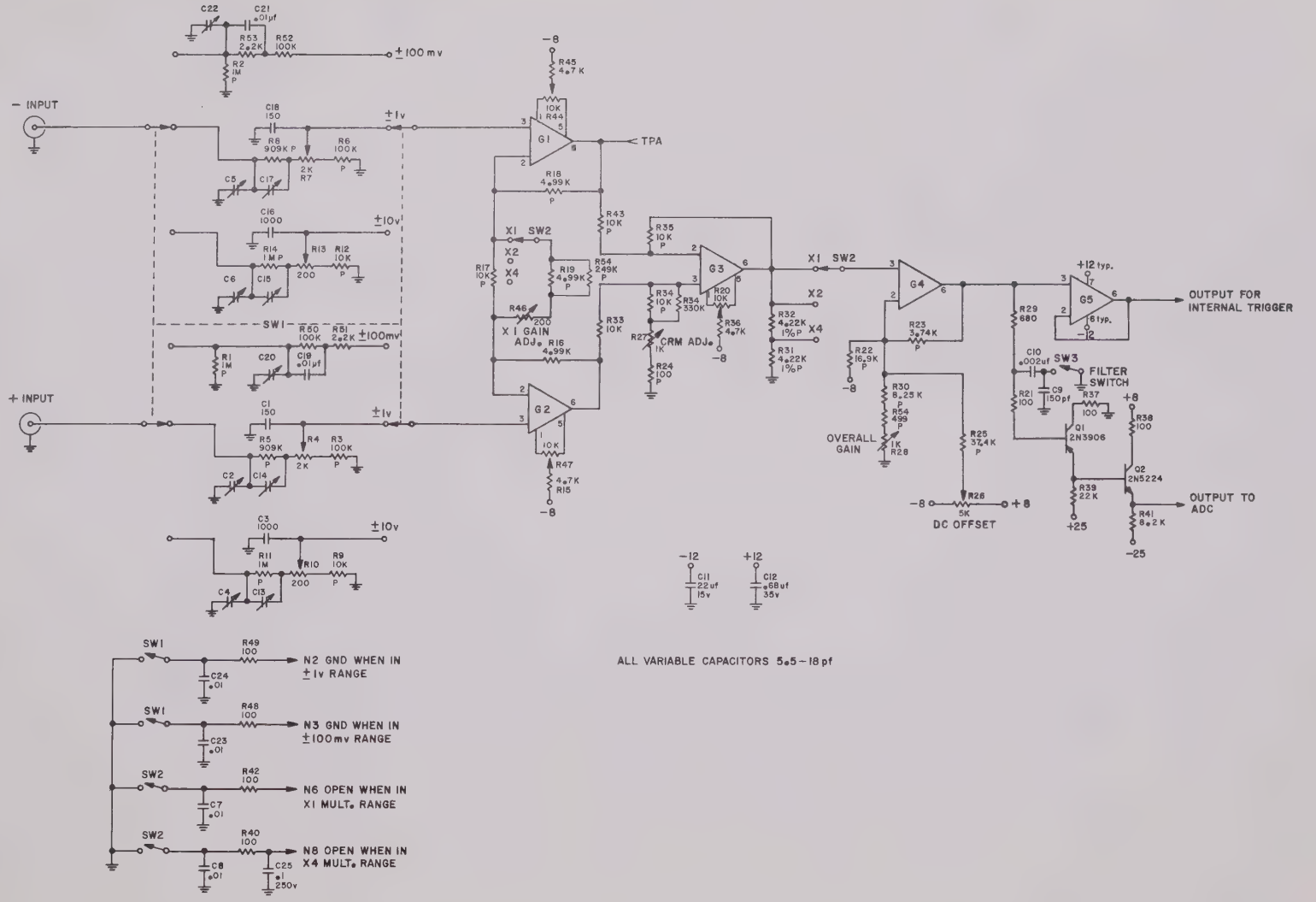
4. Do not use the RETAIN REFERENCE mode when capturing valuable information, because the data points will be lost in that mode, simply because half the memory is utilized to hold previous signal information.

E. The Type D-2 Amplifier Overload Characteristics

The drawing of Figure 8 shows the input circuit schematic of the Type D-2 Amplifier. The type CA3140 operational amplifier has a high input impedance, with a bias current of 10^{-10} amperes typically. Under over-voltage conditions, the input circuits of that device saturate and much greater currents are involved. Saturation occurs at a voltage of approximately 8 volts if the overvoltage is applied to one signal terminal, only.

For this reason, a protective resistor of 10^5 ohms, paralleled by a 0.01 nf capacitor, and another series resistor of 2200 ohms have been included to limit the current during overload. Those protective resistors allow DC overload voltage of $\pm$100 volts to be applied without damage, even when the sensitivity range selected is $\pm$100 mv. Voltages of greater than $\pm$150 volts DC are likely to cause damage to the input circuits if applied for more than a few seconds, when the most sensitive ranges are in use.

For the $\pm$1 volts and $\pm$10 volt ranges damage is possible if voltages much in excess of $\pm$200 volts are applied.



NICOLET INSTRUMENT CORP
D2 AMPLIFIER

VI. THE MAGNETIC DISK MEMORY

A. General

The magnetic disk has a storage capacity of 32 kilobytes, each byte having 13 bits. Twelve of these are used for numerical information, and the 13th is used for recording of code words indicating the settings of the oscilloscope controls that existed when each measurement was made.

The disks are removable, by opening the door at the front panel. They must be inserted right-side-up, with the small rectangular notch at the top. This notch may be covered with tape, supplied with the disks. When covered, previously recorded data are protected from being written over unintentionally, which makes it safer to use them as reference signals or for repeated study. When protected, the indicator led labelled DISK PROTECTED is energized. An alternative method of protecting is by use of the eight front panel TRACK PROTECT switches. (These do not energize the DISK PROTECTED lamp.)

The Disk is divided into 8 "tracks", each of these having a capacity of 4096 data points. To confirm with the main frame memory, which can be divided into quarters and halves, each track can also be divided into segments of 1024 storage locations each. For convenience these are named Q1, Q2, Q3, Q4 as are the main frame memory groups. These are referred to as H1 and H2. For engineering reasons, Q1 and Q3 comprise H1, and Q2 and Q4 comprise H2.

B. Track Addressing

The front panel TRACK SELECT switch may be used to step to the track location to be used next. The 8 indicator lamps show which track will be used for the next storage or recall operation. At the end of each such operation (with one exception, to be discussed in the next section) the disk controller increments the track selector. As you may have noticed, when incrementing beyond track 8, track 1 is selected next. When storing a "waveform", and a track has been protected by the TRACK PROTECT switch corresponding to that track, the selector circuits skip the protected track.

C. Segment Addressing Principles

In most store operations the entire main frame memory content is recorded, and an entire track therefore is utilized. Segments are automatically addressed, and in recall, later, the data are placed in memory just as they were recorded. Segment addressing is then of no concern to the operator.

There are circumstances in which this is not the case. For example, a disk may contain a number of waveforms* of 1024 points each, and it may be desired to retrieve one waveform only, and to place it into a particular quarter of the main frame memory. Another example is the case in which it is desired to place into the disk memory just one 1024 or

*Obviously the disk contains no "waveforms", but rather sets of digital information representing waveforms. For the sake of brevity the word waveform alone will be used in reference to information pertaining to an individual waveform.

2048 point waveform, the remainder of the main frame memory containing information of no interest. A particular section of the main frame memory must be selected, and a particular segment, or segments, of the disk may be selected, as will be described later.

(It is usually desirable to keep a log of what waveform has been placed in the memory, and its location. Sometimes that is unnecessary, if storage is to be needed for only a short time, because some waveforms are identifiable on sight, and no log is then needed.)

The disks have a large amount of storage space, and they are not expensive. It may be elected to never store more than one set of information on one track (a single waveform or a set of related waveforms), leaving in some cases part of the track blank. The waste of storage space is sometimes preferable to making the segment addressing and logging complicated by using every available segment on every track.

If that technique is used, it is preferable to avoid recording "junk" on the disk. If the main frame contains one interesting waveform, and the rest is "junk", erase the useless information and then record the entire memory content onto the selected track. This guarantees that "junk" on the disk will be replaced by the zeros in the erased portions of the main frame memory and by the interesting waveform. Leaving old information of no future interest on the disk can cause future confusion.

D. The Mechanics of Segment Addressing

1. "Normal" Operation

When the TRACK SEGMENT switch on the disk control panel is in the counterclockwise position, the disk addressing is controlled by the main frame MEMORY selector switch. The selected main frame waveform will be placed in the corresponding segment or segments of the track in use during a recording operation.

If only part of the main frame memory is to be recorded (for example, Q1 and Q3), the remainder of the track segments (Q2 and Q4) will be undisturbed on the disk.

Similarly, in a recall operation, if the Main Frame switch is in the H1 position (Q1 and Q3 are in H1), and the TRACK SEGMENT switch is in the counterclockwise position, Q1 and Q3 will be read from the disk and the remainder of the main frame memory will be undisturbed.

2. Separate Selection of Main Frame Group and Track Segments

Placing the TRACK SEGMENT Selector switch in the Q1, Q3, H1, H2, Q2 and Q4 position assures that the next recall or recording will involve only the segment or segments corresponding to that switch position. The main frame MEMORY selector has no control, then, upon which disk segment(s) will be involved; it controls where it will be placed or read from the main frame memory, only.

Always use equal-sized groups for the main frame and the disk. Don't use the H1 position for the main frame, and Q3 for the disk, for example.

3. Automatic Sequencing of Segments

The AUTOCYCLE setting of the TRACK SEGMENT switch causes both segment and track selection during recording to be automatically sequential. Starting at track 1, the addressing occurs segment by segment and track by track, until the disk is full. The "size" of the recordings (1024, 2048 or 4096 points) is determined by the main frame MEMORY switch. If the size is 1024 points, the segments are addressed in sequence, so a total of 32 waveforms will be recorded.

If the AUTOCYCLE switch position is used during recall operations, the main frame switch governs what will be seen. If in the Q3 position, for example, only segment Q3 of each track will be recalled, just as for the counterclockwise setting of that switch. It is usually preferable, when viewing information that has been automatically sequenced, to use the "ALL" position of the main frame Memory switch, so that all of the waveforms will be seen.

In the AUTOCYCLE recording mode, signal waveforms will be recorded one after another, until the disk is "full". The disk control circuits cause the main frame to switch between "Live" and "Hold", with the "Hold" mode continued long enough to record the waveform on the disk, and each "Live" mode lasting until a sweep trigger has occurred and the signal received. When the disk is full the process ends.

A special sequence is necessary to start a recording in the autocycle recording mode. It is preferable to select track 1, initially. Then switch the main frame to the "Live" mode. When ready to begin, press the HOLD NEXT pushbutton on the plug-in unit. The process then starts.

Usually, prior to actually starting the autocycle sequence, you will be "setting up" the oscilloscope to confirm proper triggering, sweep speed, etc. The oscilloscope is in the "Live" mode during this. By chance, a signal that is very interesting may occur. To save it, quickly depress the HOLD LAST pushbutton. This temporarily protects it. To record this "waveform" and also start the autocycle mode, depress the HOLD NEXT button, after the plug-in went into "Hold". To record this "waveform" and not start autocycle, manually store the waveform. You may now continue from where you left off.

The autocycle mode is useful for obtaining waveform records in rapid sequence, for such situations as during rather rapid changes in conditions within the signal source. It is also useful for obtaining a number of signals in circumstances in which they occur quite infrequently, for example once an hour. You need not be present during the several hours it takes to obtain several signals.

The recordings require no more than two seconds, most of which time involves the start-up time for the disk

drive motor. The motor does not stop at once, after each recording, but is allowed to run for several seconds. In the case in which small (1024 point) recordings are involved, the recording time is ½ second and no motor start-up time is involved if the signals occur in rapid sequence. As many as 32 records may then be obtained in a 17 second period. (The first recording involves a one second start-up delay.)

4. The LONG SWEEP Mode (Normal Trigger Only)

If the oscilloscope includes an I/O option (2090-3C), it is possible in the case of low measurement sweep speeds to store possible in the case of low measurement sweep speeds to disk, and to obtain as many as 32,768 data points for the signal, rather than the usual 4096 maximum. The segment and track addressing for the disk proceeds segment by segment until the disk is "full". In this mode, sweep speeds must be 500 µsec/point or slower for single channel or 1 msec/point or slower for 2 channels. The "waveform" can, of course, only be recalled in 4096 point increments at a time for viewing.

LONG SWEEP is selected by setting the TRACK SEGMENT switch to LONG SWEEP, the main frame MEMORY switch to ALL and the plug-in speed is set as desired. The LONG SWEEP is started by pressing STORE on the RECALL-STORE switch. The plug-in may be in "Live" or "Hold". The plug-in speed must be set correctly or inaccurate information will be placed on the disk. If the main frame switch is not in ALL, LONG SWEEP will not function. NOTE: LONG SWEEP will not operate with the 204 plug-in.

When the STORE lever is pushed, the plug-in must receive a trigger within 5 seconds if the plug-in is set for 500 μsec (single channel) or 1 msec (2 channel). The trigger can be received at any time if any other slower speed is selected.

If it is desired that a LONG SWEEP be shorter than a 32,768 point "waveform", a track other than 1 should be selected. Tracks after the starting track should not be "write protected".

When the "waveform" is recalled, the main frame MEMORY switch must be placed in ALL, as when storing.

There are two major events that happen when the "waveform" is recalled from the disk. They are described as follows:

a. A shifted "waveform" can be displayed by holding the RECALL switch. A shifted "waveform" contains part of one tracks "waveform" and part of the next tracks waveform. If the recall started at track one, the first recall would display all 4096 points of that track. If the RECALL switch is held, one second after finishing the transfer of track one, the disk will transfer the last 3 segments of track one (3072 points) and the first segment of track 2 (1024 points). If the RECALL switch is still held, one second later, the disk will transfer the last 2 segments (2048 points) of track one and the first 2 segments (2048 points) of track two. This process will continue until the RECALL switch is released which upon completion of the transfer

will cause the illuminated track "led" to advance to the next track. This whole procedure allows recalling of 4096 points of the "waveform", 1024 points further along in time, in order that portions of 2 tracks can be viewed as a continuous "waveform". The only exception is when track 8 is reached. Upon completion of recalling all of track 8, the disk will advance to track 1 in its entirety.

b. A non-shifted "waveform" can be recalled by pressing the RECALL switch and then releasing it. On completion of the transfer, the disk will advance to the next track. This mode can be selected, in the above described shifted mode, by releasing the RECALL switch any time after a transfer of a "waveform" has started, or during the one second wait period.

If the oscilloscope does not have the I/O option, but does have the disk (2090-3B), a LONG SWEEP can be recalled that was recorded on another oscilloscope having the I/O option (2090-3C). A LONG SWEEP cannot be recorded on an oscilloscope not having the I/O option. (Recalling of LONG SWEEP "waveforms" can only be done on 2090-3B oscilloscopes shipped on or after January 6, 1978. If this feature is required, consult the factory or your local representative.

E. Initiating Recordings

Ordinarily, single recordings are made by momentarily moving the RECALL STORE switch to the STORE position. If you wish, you may cause a recording to be made each time you press one of the plug-in units HOLD pushbuttons, by placing the right hand switch in the SEMIAUTOMATIC position. When the plug-in unit exits from the "Live" mode to the "Hold" mode, a recording on disk is made.

This, in some cases, is a convenience since it means that the STORE switch need not be actuated. Another use is in the case in which remote control of the plug-in unit is in use, since no operator action is needed in order to obtain several waveform recordings on the disk.

Unlike the autocycle mode of recording, the process does not end when the disk is "full", (when track 8 has been reached) the disk's track is addressed next, and the tracks are incremented in sequence again. The tracks are incremented after each recording, even if the records are only 1024 points long.

F. The Indicator Lights

1. The STORE-RECALL Led

This indicates that a store, or a recall, command has been received. It ordinarily extinguishes within 2 seconds, when the recording or recall operation has been completed. If it does not, this is an indication of a malfunction of some kind:

a. There may be no disk in the recorder.

b. The plug-in unit is in the "Live" mode.

2. I/O ACTIVE Led

This indicates that the I/O circuits of the oscilloscope are busy, and that the disk cannot be manually operated.

3. DATA ERROR Led

The disk control circuits include bit count circuits, and other circuits for sensing data errors. When an error is sensed the indicator lamp is energized. Not all data errors are detectable. Valuable data, when recorded, should be tested after recording, for visual examination, when practical. Data errors are very rare. If one occurs, it may be advisable to replace the disk.

4. DISK PROTECTED LED

When a disk has been protected by covering the rectangular slot with tape this indicator is energized. It is not energized when the track protection switches are "on".

5. Unlabelled Indicator Led

An indicator on the disk drive is energized when it is in the process of storing or recalling.

VII. EXPLORER III DIGITAL I/O

A. General

The EXPLORER III Digital I/O contains all the logic needed to transfer the display memory of the EXPLORER to an external device or to receive data from the external device and place it into the EXPLORER display memory. Operation of the EXPLORER Floppy Disk system and EXPLORER plug-ins can be accomplished from an external device through the Digital I/O.

Data format is in a 12 bit, two's complement, binary form, with a 13th bit for data normalization. Full hand-shaking capabilities are included with various inputs and outputs being used for Floppy Disk and plug-in operation.

An explanation of all signals follows. All definitions are written in positive logic, i.e.; 1=True, 0=False. Signals on the actual I/O pins are in negative logic, i.e.,; a logic 1=0 V (Ground) =True, a logic 0=5 V = False. Conversion from negative to positive logic may be required. Consult the manual on your external device.

B. I/O Control Signals

1. I/O ACTIVE (27B) (To EXPLORER)

When this signal is true, it indicates that the EXPLORER III is being controlled by an external device. Manual and external operation of the Floppy Disk Recall and Store is blocked. Manual and external track selection on the Floppy Disk can still be accomplished. When I/O Active is false, it allows manual and external control of the Floppy Disk Recall and Store.

2. DISABLE DATA OUT (28B) (To EXPLORER)

When true it disables data and normalizing output information. Disabling the data out allows wire-oring of the data out lines with other data out lines or connecting data out and data in to a bidirectional data bus.

3. DISK/PL (21B) (To EXPLORER)

a. Disk Mode, DISK/PL=1

When true, it allows operation and monitoring of the Floppy Disk as follows: (Also reference Disk Memory section).

1. RECALL:HOLD LAST (18B) (To EXPLORER)

A true pulse on this pin places the Floppy Disk into the RECALL mode.

2. STORE:HOLD NEXT (20B) (To EXPLORER)

A true pulse on this pin places the Floppy Disk into the STORE mode.

3. ATRK:RELSW (19B) (To EXPLORER)

A true pulse on this pin will advance the Floppy Disk track by one.

4. T^2:G^2; T^1:G^1; T^0:G^0 (20A,19A,18A) (From EXPLORER)

A binary output to indicate which track the Floppy Disk is currently on. Track one is equal to a binary count of 0 and track 8 is equal to a binary count of 7.

NOTE: The minimum pulse width on pins 18B, 19B, 20B (RCL, ATRK, STO) is 600 μs. A pulse of shorter duration may be missed by the Floppy Disk control circuits. After pulsing ATRK, a wait of 8 ms is required before checking the 'T's".

b. Plug-in --- Main Fame Mode, DISK/PL=0

When false, it allows operation of the plug-in and monitoring of the main frame MEMORY switch.

1. RECALL:HOLD LAST (18B) (To EXPLORER)

   A true pulse on this pin places the plug-in in HOLD LAST.

2. STORE:HOLD NEXT (20B) (To EXPLORER)

   A true pulse on this pin places the plug-in in HOLD NEXT.

3. ATRK:RELSW (19B) (To EXPLORER)

   A true pulse on this pin places the plug-in in LIVE.

4. T^2:G^2; T^1:G^1; T^0:G^0 (20A,19A,18A) (From EXPLORER)

   An output to indicate the position of the main frame MEMORY switch. The following is a table of the G outputs:

	G^2	G^1	G^0
Q1	0	0	0
Q2	0	0	1
Q3	0	1	0
Q4	0	1	1
H1	1	0	0
H2	1	0	1
ALL	1	1	0

NOTE: The minimum pulse width on pins 18B, 19B, 20B (HOLD LAST, RELSW, HOLD NEXT) is 1 μs. If

the Floppy Disk selector is in the AUTO-CYCLE position, the minimum pulse width on pin 20B (HOLD NEXT) is 600 μs.

4. I/O STEP (22B) (To EXPLORER)

A true pulse on this pin initiates a data transfer, with one I/O STEP pulse being needed for each data word to be transferred and the false to true edge of the pulse starting data transfer. (Also consult Timing Diagram.)

a. Writing Data to EXPLORER III

The data word being sent to the EXPLORER III should be ready 500 ns before I/O STEP and should be held until the I/O FLAG goes READY. (See I/O FLAG.) The D-W/R line must be true.

b. Reading Data From the EXPLORER III.

Data will be ready on the output lines when I/O FLAG goes READY. An I/O STEP pulse must be given in order to receive a data word. The D-W/R line must be false.

5. I/O RCS (17B) (To EXPLORER)

Nicolet use only. Wire pin to +5V.

6. DISK ERROR (21A) (From EXPLORER)

When true, it indicates a disk system error. This signal should be monitored after every external disk RECALL. Consult Disk Memory Section for further details.

7. I/O FLAG (22A) (From EXPLORER)

Used to indicate the status of an I/O operation. When true it indicates that the EXPLORER III is BUSY with an I/O

operation. When false it indicates that the EXPLORER III is READY to receive another word of data, or a word of data was placed on the data output bus when I/O FLAG went READY from BUSY.

8. DISK ACTIVE (23A) (From EXPLORER)

When true, it indicates that the Floppy Disk system is doing a RECALL or STORE operation.

9. LIVE (24A) (From EXPLORER)

When true, it indicates that the plug-in is in the LIVE mode. Consult the section for plug-in operation. When false, it indicates that the plug-in is in a hold condition.

Before any I/O operation is started the following signals should be checked:

I/O FLAG - False

DISK ACTIVE - False

LIVE - False

The minimum signals required for data transfer are I/O STEP, I/O FLAG, D-W/R and AC1. Consult various sections and Timing Diagram for operation.

C. DATA, ADDRESS & NORMALIZING FORMAT

1. Data

The data points are 2's complement binary representations of voltage magnitudes shown on the oscilloscope screen. There are 12 output data lines and 12 input data lines. At the I/O connector both of these are negative true logic. (0v = logic 1; 5v = logic 0).

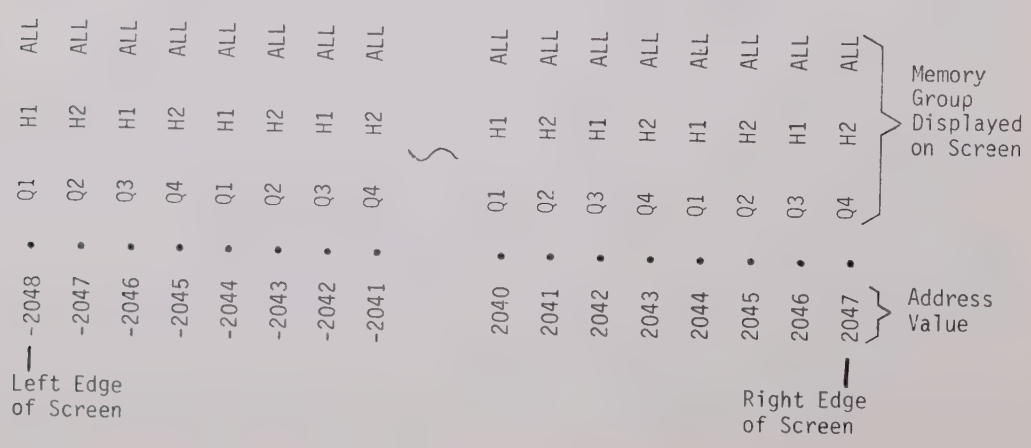
The voltage range, in binary form, is from -2048 to +2047, which is bottom screen to top screen, respectively.

2. Address

The address of the data point is proportional to the time at which the data point was measured. If the load address mode is used, the 12 input data lines are used to transfer the address to the address counter. The address is in the form of 2's compliment. "ALL" of memory has an address range of -2048 to +2047, which is left screen to right screen, respectively. At the I/O connector, it is negative true logic.

Throughout this section the address bits and words will be described using the term XAn, where n is equal to the binary bit, i.e., XAØ = LSB and XA11 = MSB. When n is missing, the binary value for XA will be listed with XA.

OSCILLOSCOPE SCREEN WITH ADDRESS VALUES SHOWN



The memory address counter is designed so only the displayed memory group can be accessed for data transfer. If a non-displayed memory group is addressed, the counterpart in the displayed group will be transferred. For example, if H1 is addressed and H2 is displayed, the data points of H2 will be transferred or if Q1 is addressed and H2 is displayed, the data points of Q2 will be transferred.

3. Normalization

The numerical information displayed on the oscilloscope screen is decoded from normalizing constants which are stored as part of the display memory. The normalizing constants are stored serially as a 13th bit that rides along with the 12-bit data words.

The normalizing bit is addressed in the same manner as the data words. The only difference is that complete normalizing information is contained in the addresses starting at 0 and ending at 1023. The addresses from 0 to 511 contain the original plug-in normalization and the addresses from 512 to 1023 contain the "NUMBERS RESET" normalization. (Numbers reset is a feature on the EXPLORER that allows a new time zero and/or voltage zero value to be selected by the operator.) The bit format for both the original and numbers reset are identical. The values for the normalizing words are identical until numbers reset is activated.

The basic normalizing format consists of four 16-bit words. The first word is the time value information which will be called "HORZ-NORM". HORZ-NORM contains three types of information about the time axis:

a. Time per point switch setting.

b. Memory group location.

c. Whether or not the time units being displayed should be normalized.

The second word is the voltage value which will be referred to as "VERT-NORM". VERT-NORM contains two types of information:

a. Voltage per level value.

b. Whether or not the voltage units being displayed should be normalized. The voltage per level value and the voltage full scale switch setting are not the same thing but they are directly related. To find the voltage per level value just divide the voltage switch setting by 2000. Any units not being normalized will display a binary value only.

The third word called "HZERO" contains the address of the data point which is considered to be time equals zero. This address is in the lower 12-bits of the 16-bit word and the upper 4 bits are zero. When "NUMBERS RESET" is used, "HZERO" contains the address of the horizontal cursor (vertical marker line).

The fourth word called "VZERO" contains a binary value of zero. When "NUMBERS RESET" is used, "VZERO" contains the binary value of where the vertical cursor (horizontal marker line) is located.

This set of four 16-bit words is needed for each waveform stored in the EXPLORER display memory. This occurs when four, two channel measurements are made with the MEMORY switch set to a quarter for each measurement. Usually there are not eight waveforms in memory so the same pattern is duplicated and if a single waveform is stored in of memory the eight normalizing sets will be identical. HNORM, HZERO and VZERO can only have four different possible normalization values as both channels, in 2 channel, use the same time per point and numbers reset values.

If more than one waveform is in memory, the data points are alternated on the display screen. This is also true of the four normalizing word-sets.

Normalizing must be thought of as 64 16-bit words multiplexed in serialized form in memory as one bit, where 8 different Nx's are stored before Nx+1 is stored. This multiplex scheme has, for example, all 8 NØ's stored in one area of memory for a given word before the 8 N1's are stored in memory. This multiplexing scheme can be seen in TABLE 1.

Following are three tables which describe the normalizing constants. TABLE 1 shows the memory address location for each normalizing bit. TABLE 2 shows the normalizing value for HORZ-NORM & VERT-NORM in abreviated form. TABLE 3 shows HORZ-NORM & VERT-NORM as stored as a 16-bit normalizing word.

TABLE 1

NORMALIZING WORD ADDRESS BIT = XA

XA11 = XA10 = 0

XA9		XA8	XA7	NORM. WORDS
0	Plug-in Original	0	0	HORZ NORM
		0	1	VERT NORM
1	Numbers Reset	1	0	HZERO
		1	1	VZERO

XA6	XA5	XA4	XA3	NORM BIT
0	0	0	0	N0 LSB
0	0	0	1	N1
0	0	1	0	N2
0	0	1	1	N3
0	1	0	0	N4
0	1	0	1	N5
0	1	1	0	N6
0	1	1	1	N7
1	0	0	0	N8
1	0	0	1	N9
1	0	1	0	N10
1	0	1	1	N11
1	1	0	0	N12
1	1	0	1	N13
1	1	1	0	N14
1	1	1	1	N15 MSB

XA2	XA1	XA0	MEMORY GROUP Where N's are Stored		
0	0	0	Q1-ChA	H1-ChA	ALL-ChA
0	0	1	Q2-ChA	H2-ChA	ALL-ChB
0	1	0	Q3-ChA	H1-ChB	ALL-ChA
0	1	1	Q4-ChA	H2-ChB	ALL-ChB
1	0	0	Q1-ChB	H1-ChA	ALL-ChA
1	0	1	Q2-ChB	H2-ChA	ALL-ChB
1	1	0	Q3-ChB	H1-ChB	ALL-ChA
1	1	1	Q4-ChB	H2-ChB	ALL-ChB

Note: that if a single channel measurement was made,

NORMALIZING WEIGHT FACTOR FOR HORZ-NORM & VERT-NORM

N12 = N13 = N14 = N15 = 1 for not normalized

$4096 \div 2^n$ data points		Memory Group During Measurement
N11	N10	
0	0	ALL
0	1	H's
1	0	Q's
1	1	8th's

$x2^n$		$\div 2^n$		
N9	N8	N7	N6	MULT.
0	1	1	0	X0.5
0	1	0	1	X 1
0	1	0	0	X 2
0	0	1	0	X0.25
0	0	0	1	X .5
0	0	0	0	X 1

$X10^{-3n}$		$X10^n$		$\div 10^n$		
N5	N4	N3	N2	N1	N0	DECADE
1	1	1	0	0	0	100 nano
1	0	0	0	0	0	1 micro
1	0	0	1	0	0	10 micro
1	0	1	0	0	0	100 micro
0	1	0	0	0	0	1 milli
0	1	0	1	0	0	10 milli
0	1	1	0	0	0	100 milli
0	0	0	0	0	0	1
0	0	0	1	0	0	10
0	0	1	0	0	0	100

For HORZ-NORM the result of MULT X DECADE equals the time per point.

For VERT-NORM the result of MULT X DECADE equals the voltage per level.

For all plug-ins designed to date note that:

HNØ = HN1 = Ø; HN8 = 1
VNØ = VN5 = VN7 = VN9 = VN10 = VN11 = Ø
VN1 = VN4 = 1
N13 = N14 = N15 will follow (=) N12

0.25 mult. is not implemented in main frames shipped to date

TABLE 3

VOLTAGE

Range	Norm bit 15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
10 mv	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0
20 mv	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
40 mv	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0
100 mv	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0
200 mv	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0
400 mv	0	0	0	0	0	0	0	1	0	0	0	1	0	1	1	0
1 v	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1	0
2 v	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0
4 v	0	0	0	0	0	0	0	1	0	0	0	1	1	0	1	0
10 v	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	0
20 v	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
40 v	0	0	0	0	0	0	0	1	0	0	0	1	1	1	1	0
	$\overline{\text{NORM}}$				MG		$\times 2^n$		$\div 2^n$		$\times 10^{-3n}$		$\times 10^n$		$\div 10^n$	
							MULT				DECADE					

TIME

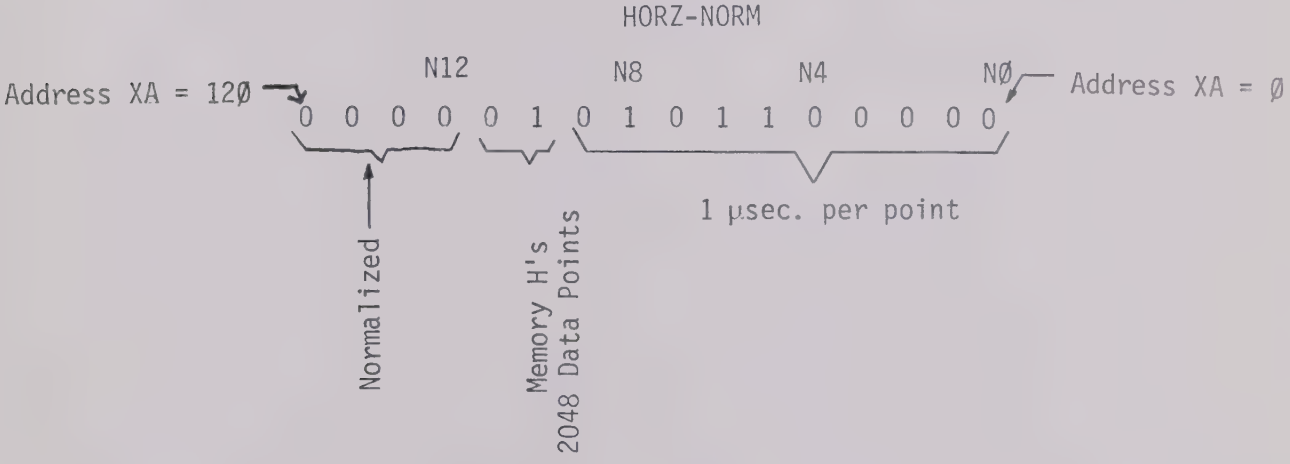
Range	Norm bit 15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
50 ns	0	0	0	0	X	X	0	1	1	0	1	1	1	0	0	0
100 ns	0	0	0	0			0	1	0	1	1	1	1	0	0	0
200 ns	0	0	0	0			0	1	0	0	1	1	1	0	0	0
500 ns	0	0	0	0			0	1	1	0	1	0	0	0	0	0
1 µs	0	0	0	0			0	1	0	1	1	0	0	0	0	0
2 µs	0	0	0	0			0	1	0	0	1	0	0	0	0	0
5 µs	0	0	0	0			0	1	1	0	1	0	0	1	0	0
10 µs	0	0	0	0			0	1	0	1	1	0	0	1	0	0
20 µs	0	0	0	0			0	1	0	0	1	0	0	1	0	0
50 µs	0	0	0	0			0	1	1	0	1	0	1	0	0	0
100 µs	0	0	0	0			0	1	0	1	1	0	1	0	0	0
200 µs	0	0	0	0			0	1	0	0	1	0	1	0	0	0
500 µs	0	0	0	0			0	1	1	0	0	1	0	0	0	0
1 ms	0	0	0	0			0	1	0	1	0	1	0	0	0	0
2 ms	0	0	0	0			0	1	0	0	0	1	0	0	0	0
5 ms	0	0	0	0			0	1	1	0	0	1	0	1	0	0
10 ms	0	0	0	0			0	1	0	1	0	1	0	1	0	0
20 ms	0	0	0	0			0	1	0	0	0	1	0	1	0	0
50 ms	0	0	0	0			0	1	1	0	0	1	1	0	0	0
100 ms	0	0	0	0			0	1	0	1	0	1	1	0	0	0
200 ms	0	0	0	0			0	1	0	0	0	1	1	0	0	0
500 ms	0	0	0	0			0	1	1	0	0	0	0	0	0	0
1 sec	0	0	0	0			0	1	0	1	0	0	0	0	0	0
2 sec	0	0	0	0			0	1	0	0	0	0	0	0	0	0
5 sec	0	0	0	0			0	1	1	0	0	0	0	1	0	0
10 sec	0	0	0	0			0	1	0	1	0	0	0	1	0	0
20 sec	0	0	0	0			0	1	0	0	0	0	0	1	0	0
50 sec	0	0	0	0			0	1	1	0	0	0	1	0	0	0
100 sec	0	0	0	0			0	1	0	1	0	0	1	0	0	0
200 sec	0	0	0	0	▼	▼	0	1	0	0	0	0	1	0	0	0
	$\overline{\text{NORM}}$				MG		$\times 2^n$		$\div 2^n$		$\times 10^{-3n}$		$\times 10^n$		$\div 10^n$	
							MULT				DECADE					

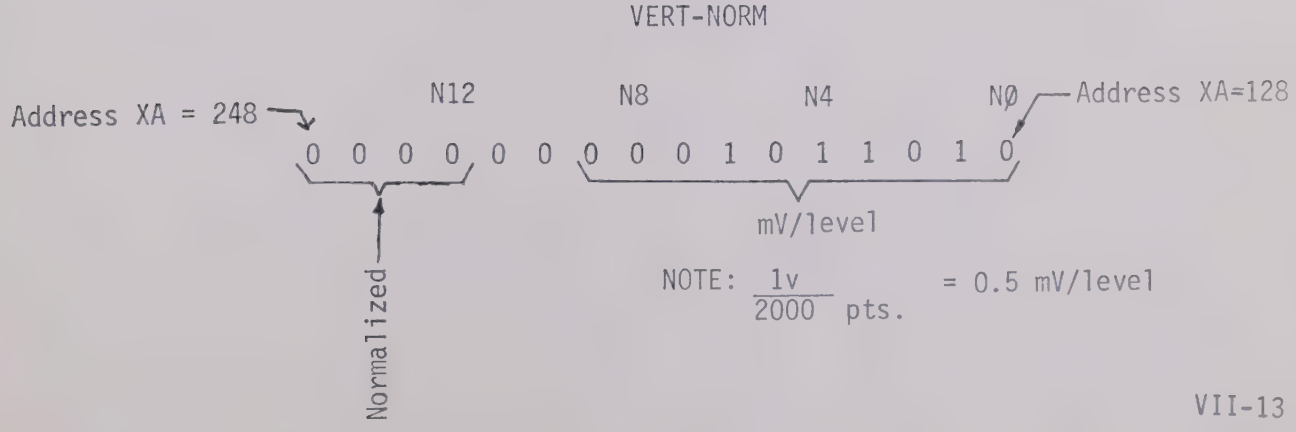
Normalizing Example:

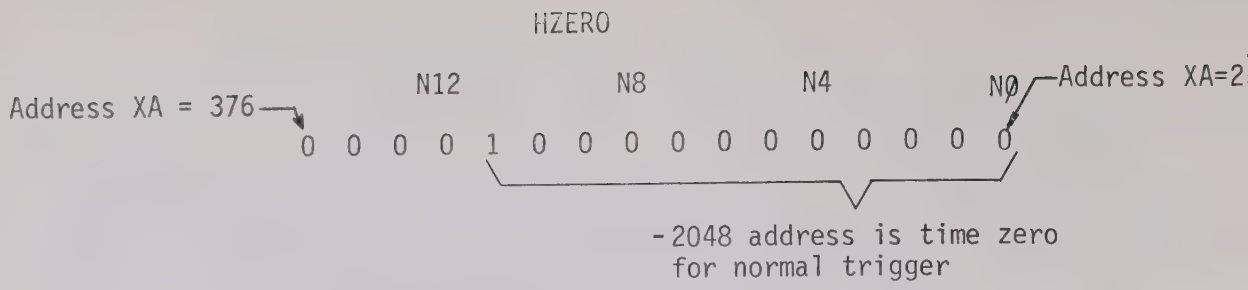
A measurement was made in H1 and it was done with only one channel on. The plug-in switch settings are 1 μsec per point, 1V, and normal trigger. The first bit, NØ, of HORZ-NORM is located at address, XA = Ø. This first bit. NØ, is also duplicated at address 2, 4 and 6.

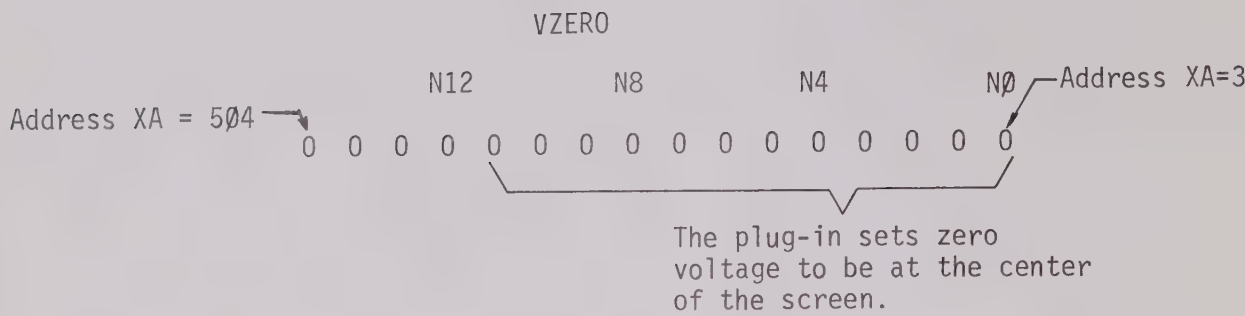
The first bit, NØ, for VERT-NORM is located at address 128, 130, 132 and 134. The addresses listed below are for the original plug-in values, if the numbers reset is to be addressed just add 512 to these addresses.

The next normalization bit in each word will be XA + 8 higher than the previous bit.









The normalizing information can be transferred simultaneously with the data points or it can be transferred separately.

A minimum of 16, 16-bit words, or registers, will be required to store all possible combinations of normalization constants for the original plug-in normalization. They break down as follows:

8 - VNORM

4 - HNORM

4 - HZERO

Ø - VZERO (always equal to Ø)

A minimum of 20 more words, or registers will be required for the NUMBERS RESET normalization, if used. The extra 4 words are for VZERO, which can be other than zero. A maximum of 64 words, 32 for each section of plug-in normlaization, will be needed if each of the normalization words are stored by the user's equipment.

5. Memory Read or Memory Write Selectors for Data and Normalizing Transfer

D-W/R	N-W/R	Data	Normalizing
0	0	Read	Read
1	0	Write	No Operation
0	1	No Operation	Write
1	1	Write	Write

These Read-Write selectors allow the Data and Normalizing information to be transferred independently.

When a memory address is loaded into the address counter it is not necessary to change the Read-Write selectors. This means the Read-Write selector states are only applicable during a data or normalizing transfer operation.

Memory Addressing Modes: (Controlled by AC1 and AC2)

AC2	AC1		
0	0	Load Address	Immediately after this mode is entered the address counter is cleared and the load address state is set. Clearing the address counter operation is used in conjunction with the Advance Address modes. When the load state is set, the first information that is transferred to the I/O interface is the memory address. A data point can then be transferred in or out of the memory location that was addressed. The alternating address and data process repeats as long as the load address mode is selected.

When a new I/O transfer sequence is initiated in the load address mode, the load address mode should be entered from another mode (usually advance address by one). This will insure that the first information transferred is interpreted by the I/O interface as an address and not data.

AC2	AC1		
0	1	Advance Address by One	This mode automatically advances to the next memory address after a data point is transferred. The starting address can be set in one of two ways. The load address mode is entered from some other mode. This does two things; it sets the load address state and resets the address counter to the left edge of the oscilloscope screen. If the mode is now changed to Advance Address by one the first data point transferred will be on the left edge of the screen. If an address is entered before the mode is changed to Advance Address by One the first data point transferred will be located at the address which was loaded in.

AC2	AC1		
1	0	Advance Address by Quarters	This mode is similar to the Advance Address by One mode. The only difference is that it automatically advances by Quarters count instead of by one. Quarters Count: All, advances by four. H's advances by two. Q's advances by one.
AC2	AC1	Hold Address	This mode is used to hold the address counter at a particular location. When this mode is entered no address can be loaded and no automatic address advance will take place. Data transfers will occur at the same address location until a different mode is selected.
1	1		

D. TRANSFER HANDSHAKE OPERATION

Two I/O signals are allocated for Address, Data and Normalizing transfer operations. An input signal labeled I/O-STEP is used to pulse the I/O circuits to initiate an I/O transfer. This transfer operation may be an Address input, a Data input or output, and/or a Normalizing input or output. The output signal labeled I/O-FLAG can be used as a status line to inform the user's external device that the EXPLORER III is ready for a data transfer. (Ready=0, Busy=1). The I/O-FLAG goes to busy immediately after the I/O-STEP lines goes from 0 to 1, unless the DISK ACTIVE signal is true. When an address is transferred into EXPLORER III, I/O-FLAG will stay busy for 1.25 μs. When data or normalizing is transferred, I/O-FLAG will stay busy for 2 μs if the plug-in is in a hold condition. If the plug-in is LIVE, I/O-FLAG will go busy and stay busy until the plug-in goes to hold and the I/O transfer can go to completion. The plug-in delays the I/O transfer because the plug-in and the I/O exchange data with the display memory on the same data bus.

It is unusual for the plug-in to be in LIVE and for an I/O transfer to be in progress because the plug-in will change the data stored in the display memory.

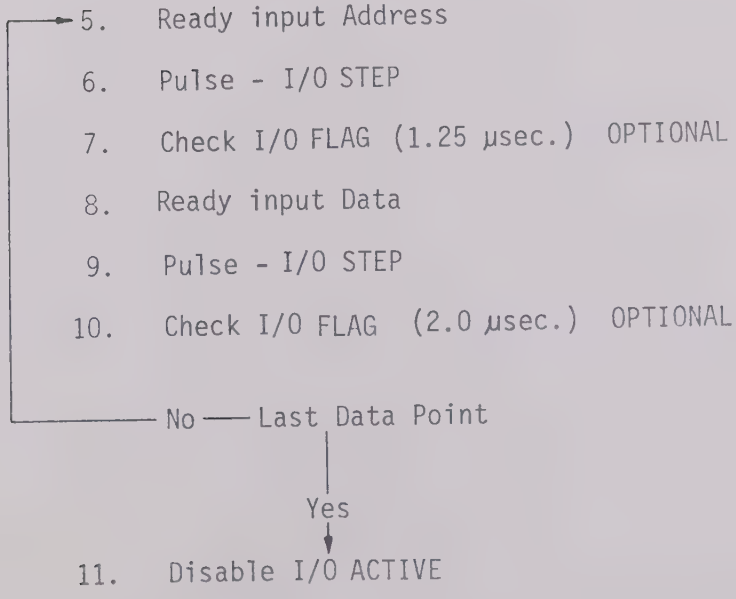
If the user knows the plug-in will not be activated during an I/O transfer, the I/O-FLAG line need not be monitored as long as the I/O-STEP pulses are a minimum of 3 μs apart. If the user wishes to monitor the I/O-FLAG line, a circuit should be implemented to sense the busy to ready (1 to 0) transition of the

I/O-FLAG. This transition will tell the user's sytem that the I/O transfer is complete.

Beware that if the user's system does not activate the I/O-ACTIVE line for the I/O transfer the disk could be manually operated and destroy the I/O data. If this sequence occurs the I/O-FLAG will go to ready even if the I/O transfer is not complete.

Write to 2090-III Display Memory (Load Address)

1. Set I/O ACTIVE.
2. Wait until disk is not active & plug-in is not Live.
3. Set Load Address mode on A.C. lines (pulse from another mode if in load).
4. Set N-$\frac{R}{W}$ and/or D-$\frac{R}{W}$ to write.



Read From 2090-III Display Memory (Load Address)

1. Set I/O ACTIVE.
2. Wait until disk is not active and plug-in is not Live.
3. Set Load Address mode on A.C. lines (pulse from another mode if in load).
4. Set N-$\frac{R}{W}$ and D-$\frac{R}{W}$ to read.
5. Ready input address.
6. Pulse-I/O STEP
7. Check I/O FLAG (1.25 μsec.) OPTIONAL
8. Pulse - I/O STEP
9. Check I/O FLAG (2.0 μsec.) OPTIONAL
10. Output Data Available

No — Last Data Point

Yes

11. Disable I/O ACTIVE

Write to 2090-III Memory (Advance After Each Data Point)

1. Set I/O ACTIVE
2. Wait until disk is not active and plug-in is not Live.
3. Set Advance Address mode on A.C. lines (go to load address to clear address counter).
4. Set N-$\frac{R}{W}$ and/or D-$\frac{R}{W}$ to write.
5. Ready input Data
6. Pulse - I/O STEP
7. Check I/O FLAG (2 μsec.) OPTIONAL

No — Last Data Point

Yes

8. Disable I/O ACTIVE

Read From 2090 III Memoery (Advance After Each Data Point)

1. Set I/O ACTIVE.
2. Wait until disk is not active and plug-in is not Live.
3. Set Advance Address mode on A.C. lines (go to load address to clear address
4. Set N-$\frac{R}{W}$ and D-$\frac{R}{W}$ to read.
5. Pulse - I/O STEP
6. Check I/O FLAG (2 μsec.) OPTIONAL
7. Output data available.

No — Last Data Point

Yes

8. Disable I/O ACTIVE

E. I/O - LINE DRIVERS & RECEIVERS

1. I/O Output Lines

These signals are driven by open-collector TTL gates, 7438, capable of sinking 48mA. The suggested line termination for each output signal is a 220Ω resistor to +5 and a 330Ω resistor to ground.

2. I/O Input Lines

These signals are terminated, on the Option 002 and 003 board, with a 220Ω resistor to +5V and a 330Ω resistor to ground. These signals are received with Schmitt Triggers for better noise immunity. These lines should be driven with a device having a minimum sink current of 21mA.

F. RECOMMENDED DRIVERS & RECEIVERS

For a users system that has a positive logic internal bus structure the 74LS240 can be used to drive and receive. The 74LS240 has the advantage of hysteresis inputs for increased noise immunity as a receiver and it has 3-state outputs for the user's system bus multiplexing. It also does the negative to positive logic inversion for the drivers and receivers.

For a users system that has a negative logic internal bus structure, the 74LS244 can be used with the same advantages as the 74LS240. Here the driver and receiver logic inversion is not needed.

DATA & NORMALIZING READ-WRITE CONTROL

(25B) N-W/R	(26B) D-W/R	Normalizing	Data
0	0	Read	Read
0	1	No Operation	Write
1	0	Write	No Operation
1	1	Write	Write

Read-Data and/or normalizing is taken from the 2090 display memory and latched onto the DO and/or NO signal lines.

Write-Data and/or normalizing is taken from the DI and/or NI signal lines and stored in the display memory.

ADDRESS MODE CONTROL

AC2(24B)	AC1(23B)	
0	0	Load Address
0	1	Advance Address + 1
1	0	Advance Address + Q
1	1	Hold Address

DISK & PLUG-IN CONTROL

DISK:PLUG-IN

DISK/PL=1 DISK/PL=0

EXPLORER III - I/O - SIGNAL LISTING

I/O CONNECTOR, OPTION 002 and OPTION 003

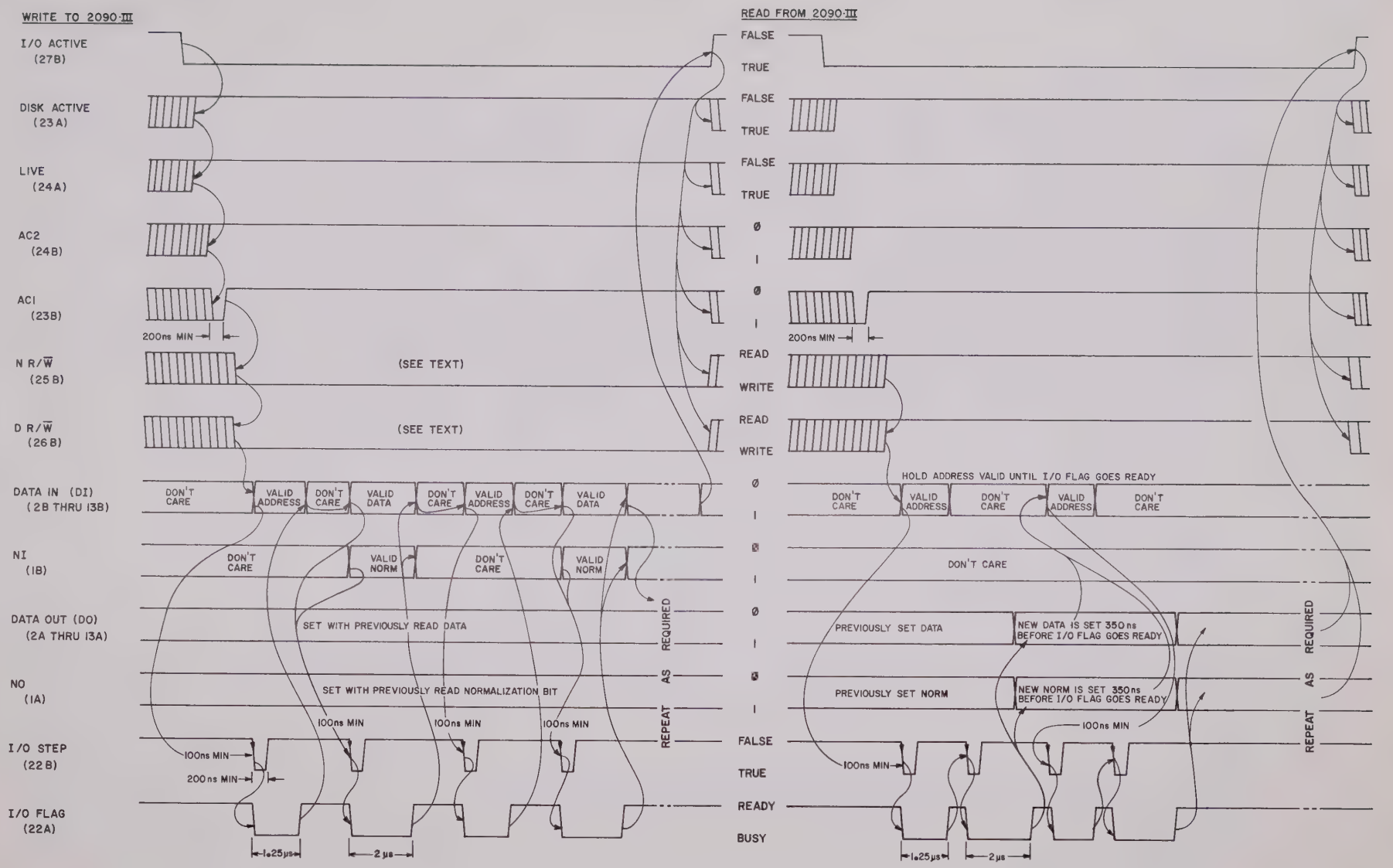
I/O-Board Connector Pin No.	OUTPUT SIGNAL	OPTION 003 LOWER CABLE Twisted Pair Wire Color	Cable Connector No.
1A	NO	1	1
2A	DO 0 (LSB)	2	3
3A	DO 1	3	5
4A	DO 2	4	7
5A	DO 3	5	9
6A	DO 4	6	11
7A	DO 5	7	13
8A	DO 6	8	15
9A	DO 7	9	17
10A	DO 8	0	19
11A	DO 9	1	21
12A	DO 10	2	23
13A	DO 11 (MSB)	3	25
14A	GND	-	
15A	GND	-	
16A	GND	-	
17A	NC	4	27
18A	TO:GO	5	29
19A	T1:G1	6	31
20A	T2:G2	7	33
21A	DISK ERROR	8	35
22A	I/O-FLAG (Busy=1)	9	37
23A	DISK ACTIVE	0	39
24A	LIVE	1	41
25A	NC	GND 2	43
26A	NC	GND 3	45
27A	NC	GND 4	47
28A	NC	GND 5	49

I/O-Board Connector Pin No.	INPUT SIGNAL	OPTION 003 UPPER CABLE Twisted Pair Wire Color	Cable Connector No.
1B	NI	1	1
2B	DI 0 (LSB)	2	3
3B	DI 1	3	5
4B	DI 2	4	7
5B	DI 3	5	9
6B	DI 4	6	11
7B	DI 5	7	13
8B	DI 6	8	15
9B	DI 7	9	17
10B	DI 8	0	19
11B	DI 9	1	21
12B	DI 10	2	23
13B	DI 11 (MSB)	3	25
14B	+5	-	
15B	+5	-	
16B	+5	-	
17B	I/O-RCS	4	27
18B	RECALL:HOLD LAST	5	29
19B	TRK-FORWARD:RELSW	6	31
20B	STORE:HOLD NEXT	7	33
21B	DISK/PL	8	35
22B	I/O-STEP	9	37
23B	AC1	0	39
24B	AC2	1	41
25B	N-W/R	2	43
26B	D-W/R	3	45
27B	I/O-ACTIVE	4	47
28B	Disable Data Out	5	49

Negative true logic; 2's compliment;1 = ground; 0 = +5V; ground/+5V

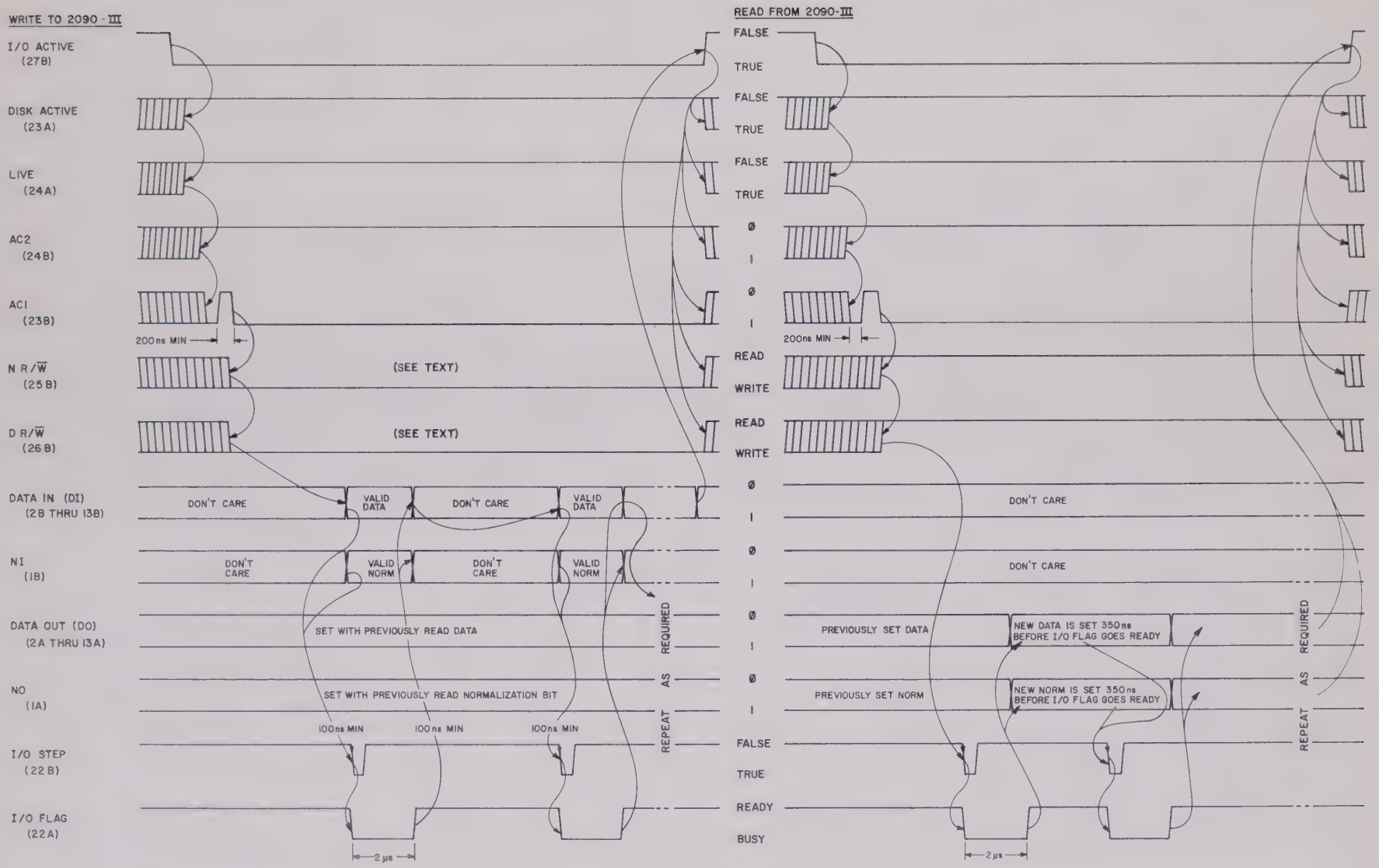
Cable Connector - tan color and even pin numbers are twisted shield.

LOAD ADDRESS MODE

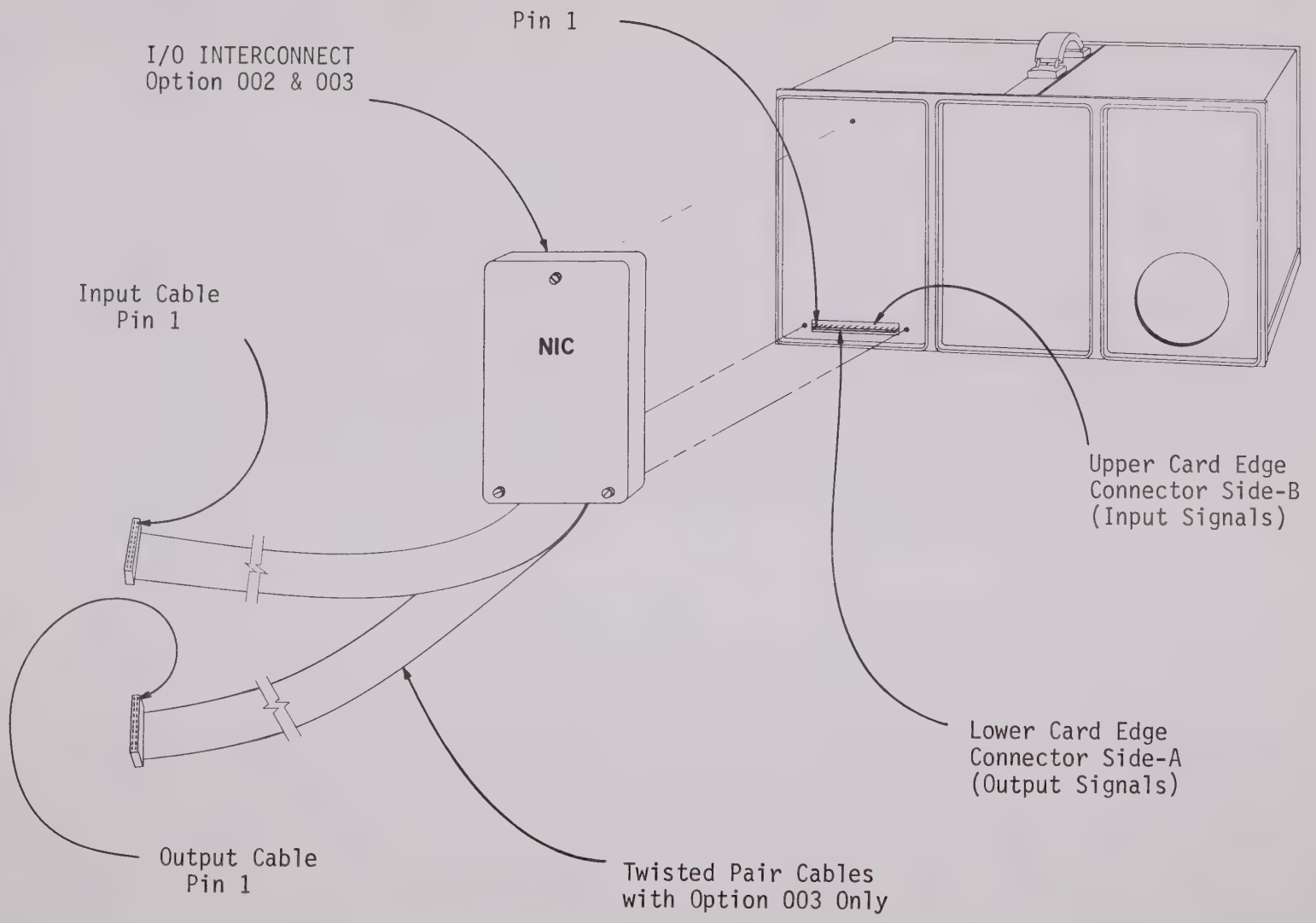


THIS TIMING DIAGRAM SHOWS SIGNAL LEVELS ON THE PINS OF THE 2090-III I/O CONNECTOR
FALSE = +5v = LOGIC 0, TRUE = 0v = LOGIC 1
UNLESS OTHERWISE STATED, RELEASE OR HOLD TIMES ARE 0 µs.

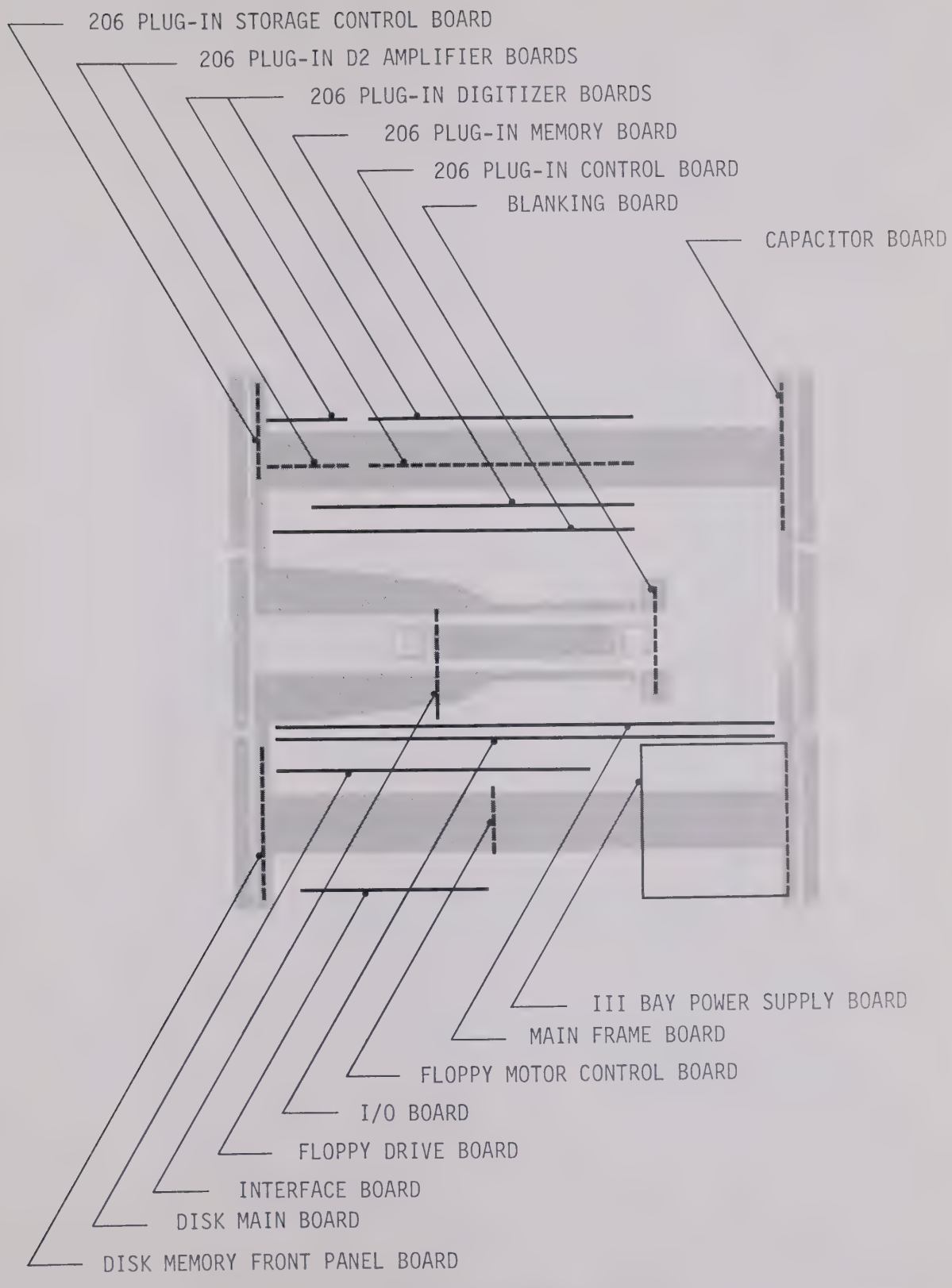
ADVANCE ADDRESS MODE



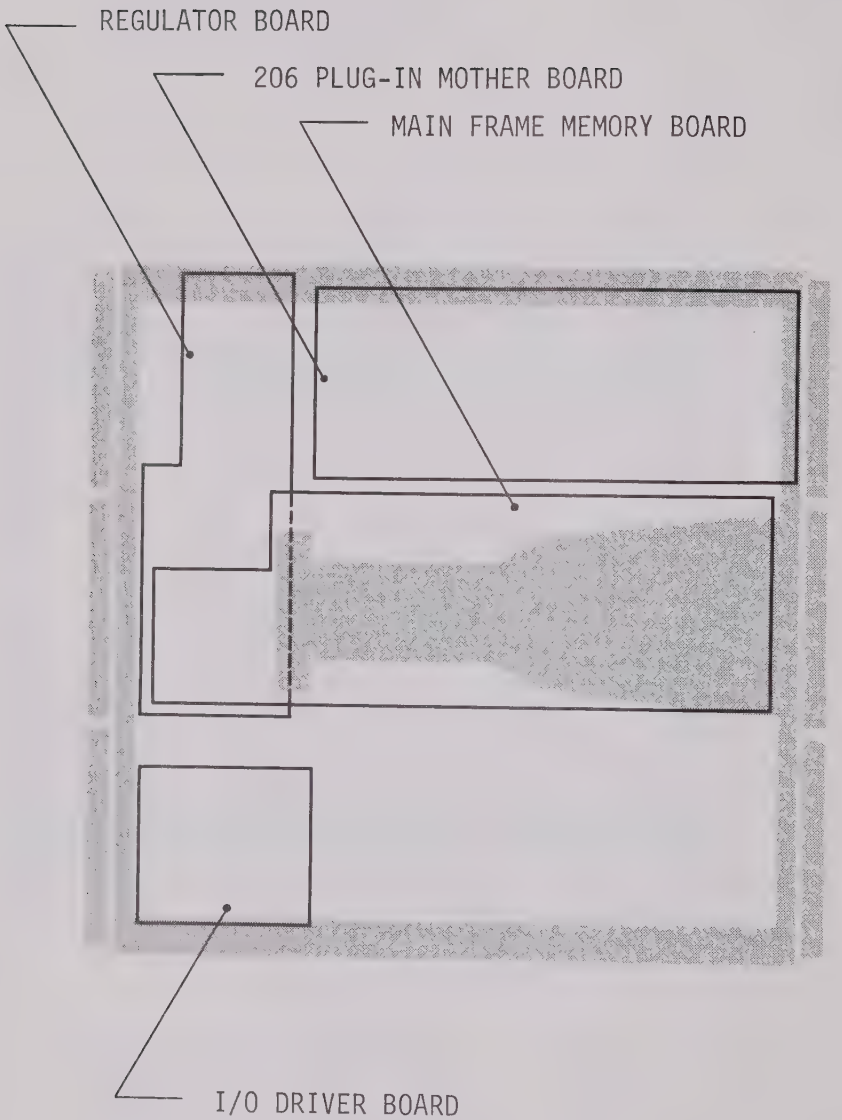
THIS TIMING DIAGRAM SHOWS SIGNAL LEVELS ON THE PINS OF THE 2090-III I/O CONNECTOR
FALSE = +5v = LOGIC Ø, TRUE = Øv = LOGIC I
UNLESS OTHERWISE STATED, RELEASE OR HOLD TIMES ARE Ø µs.



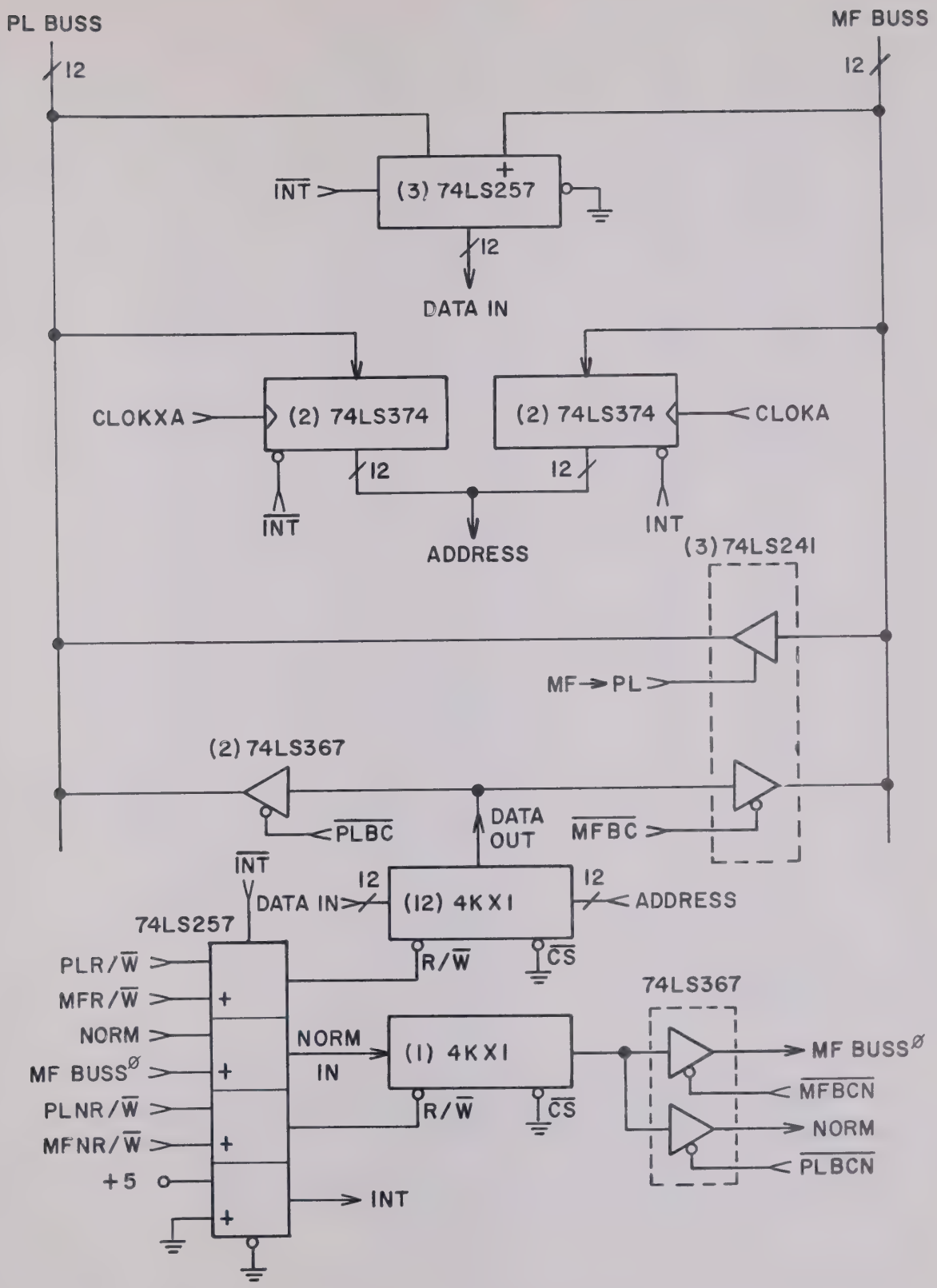
NICOLET INSTRUMENT CORP		
TITLE		
DRAWN	SIZE C	DWG. NO.
CHECKED		



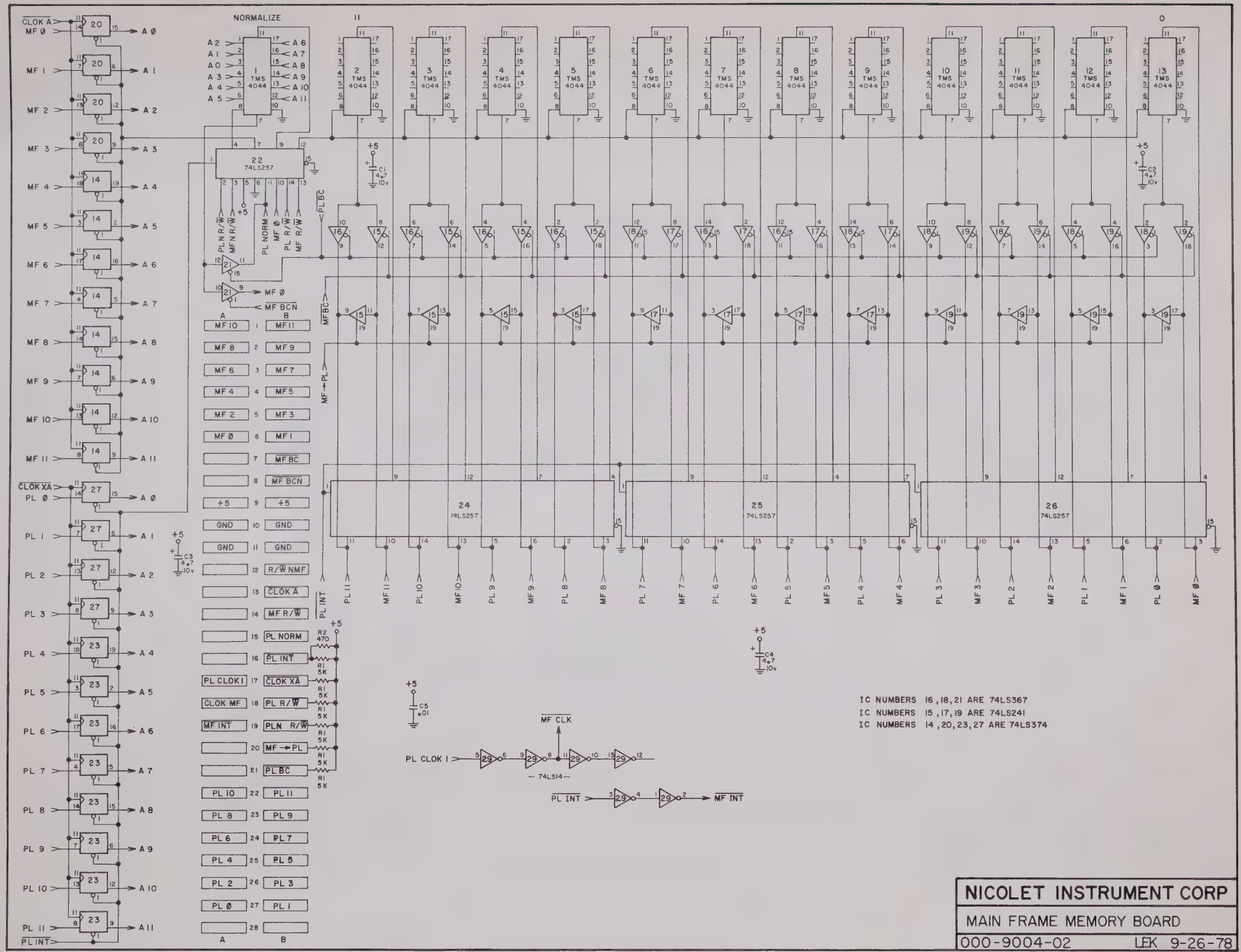
BOARD PLACEMENT DIAGRAM
TOP VIEW



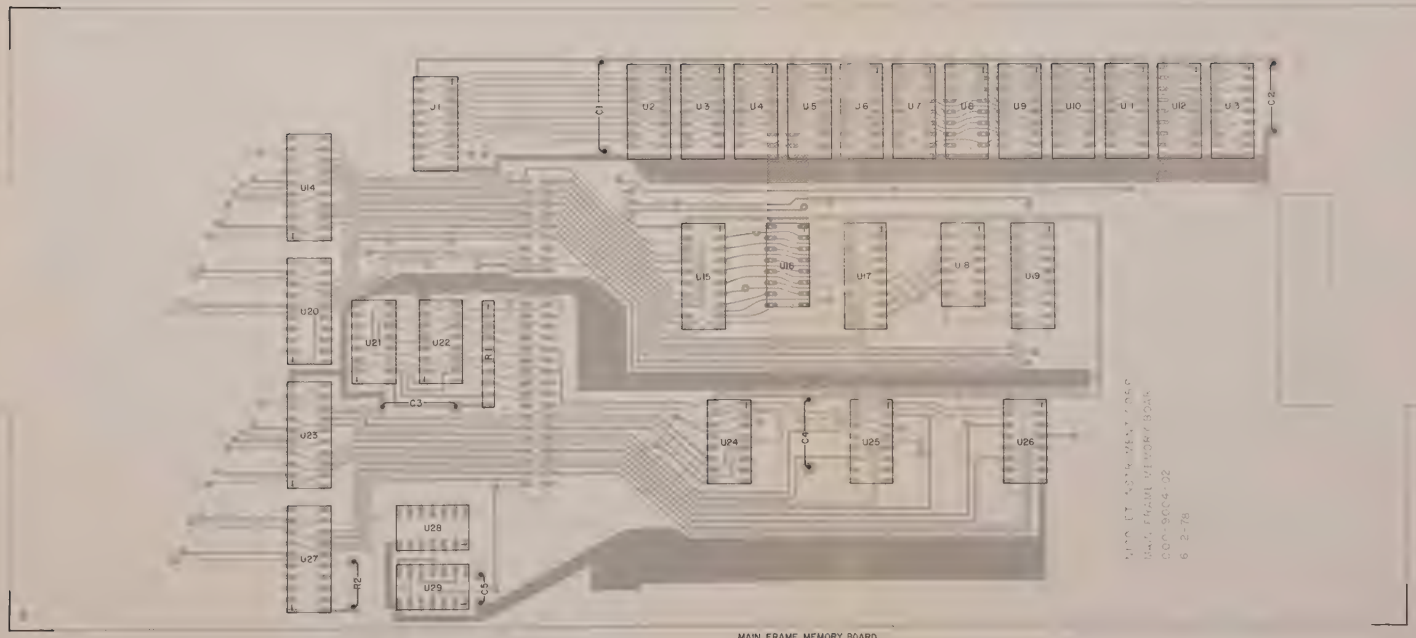
BOARD PLACEMENT DIAGRAM
BOTTOM VIEW



4K RAM MAIN FRAME



NICOLET INSTRUMENT CORP	
MAIN FRAME MEMORY BOARD	
000-9004-02	LEK 9-26-78



MAIN FRAME MEMORY BOARD
— CONDUCTOR SIDE —

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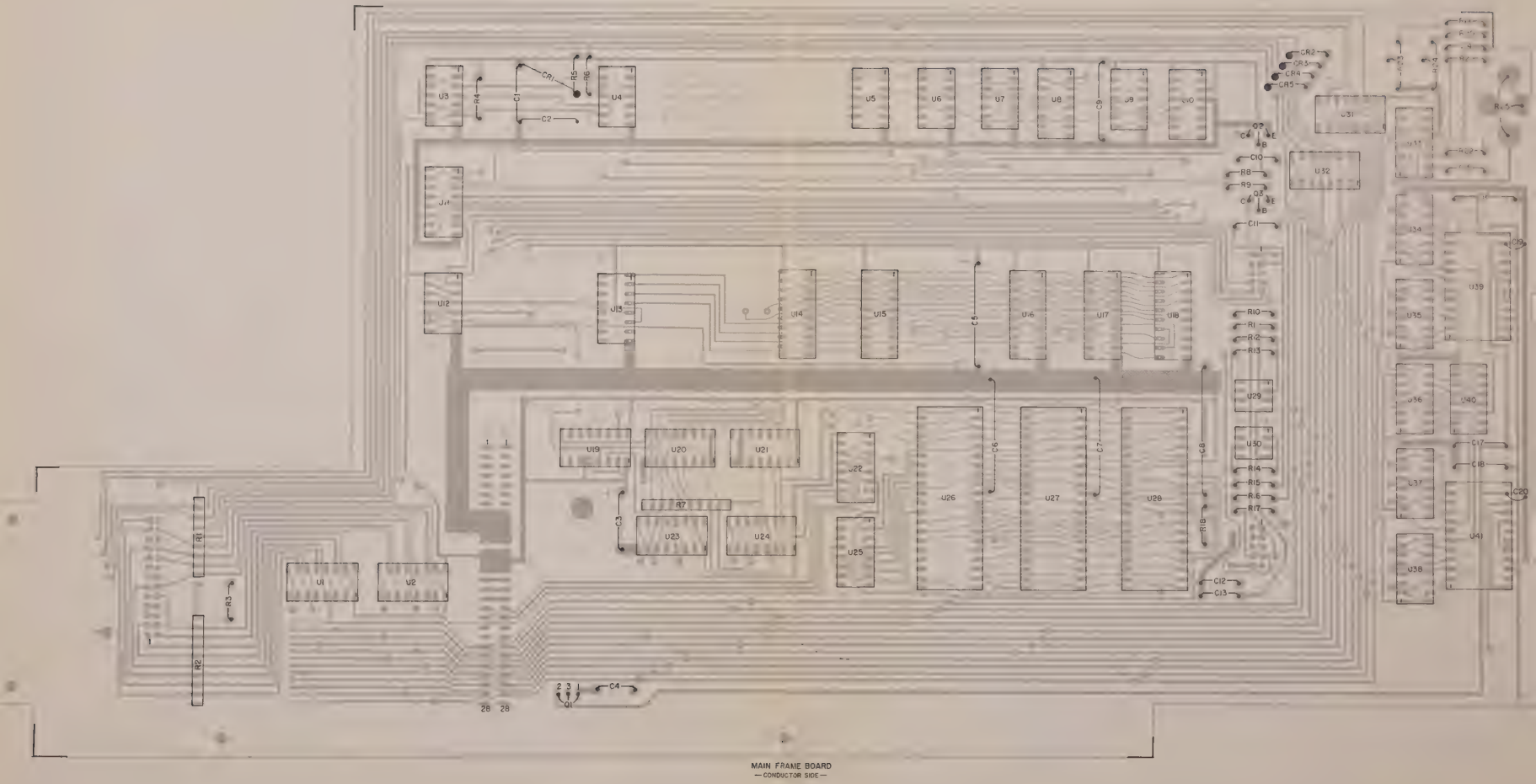

MAIN FRAME BOARD
— CONDUCTOR SIDE —

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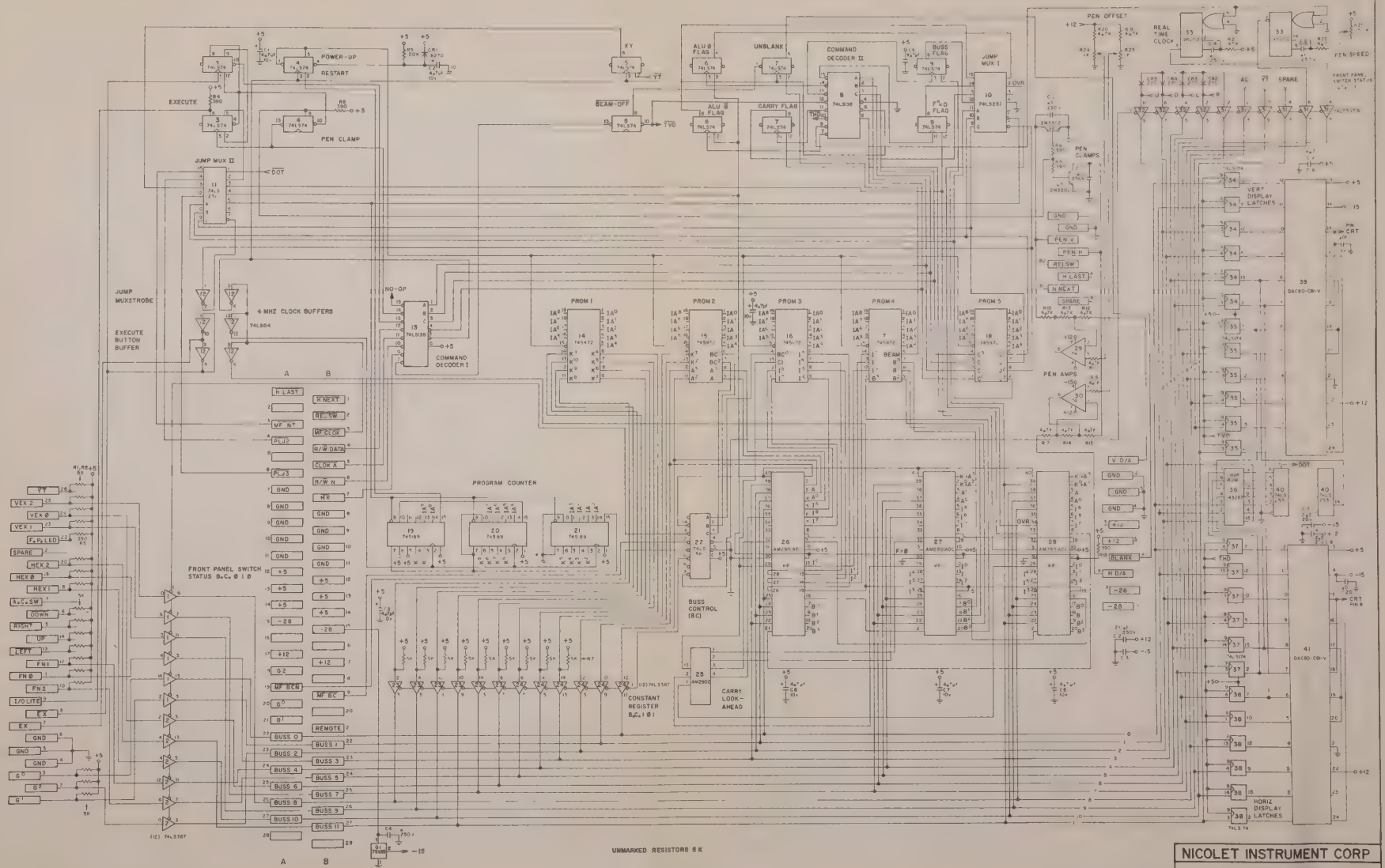
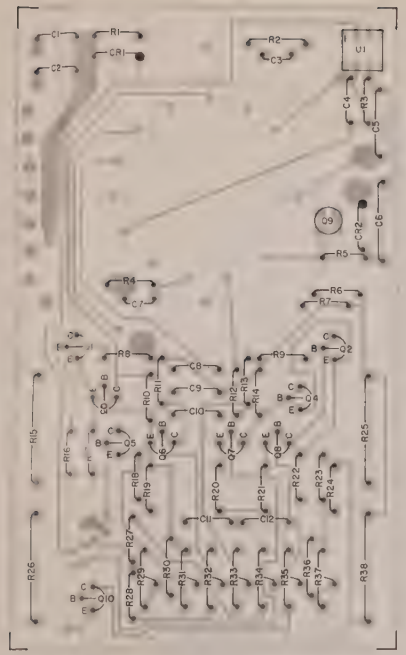
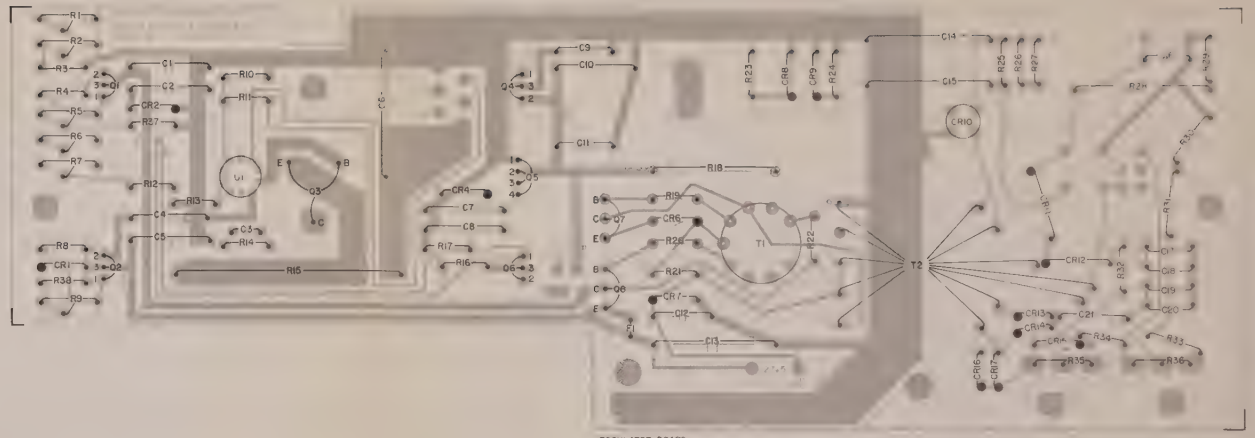


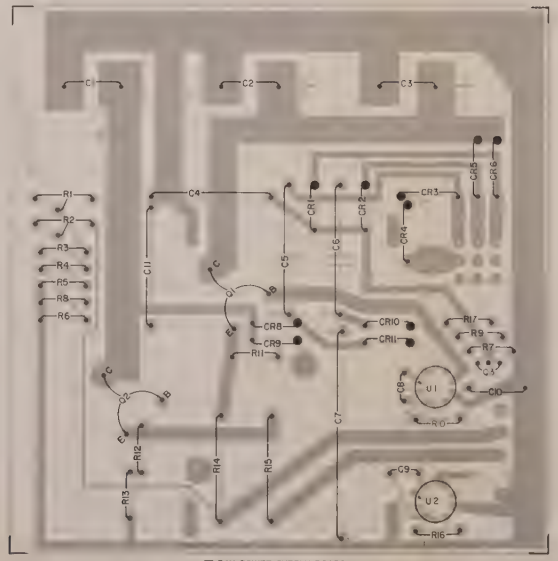
NICOLET INSTRUMENT CORP	
MAIN FRAME BOARD	
000-9003-02	LEK 11-29-79



BLANKING BOARD
— CONDUCTOR SIDE —



REGULATOR BOARD
— CONDUCTOR SIDE —



III BAY POWER SUPPLY BOARD
— CONDUCTOR SIDE —

CAPACITOR BOARD
— CONDUCTOR SIDE —

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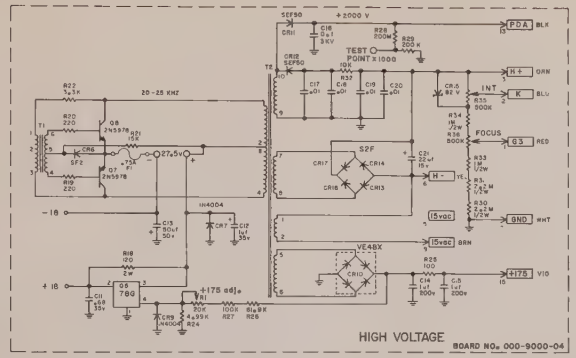
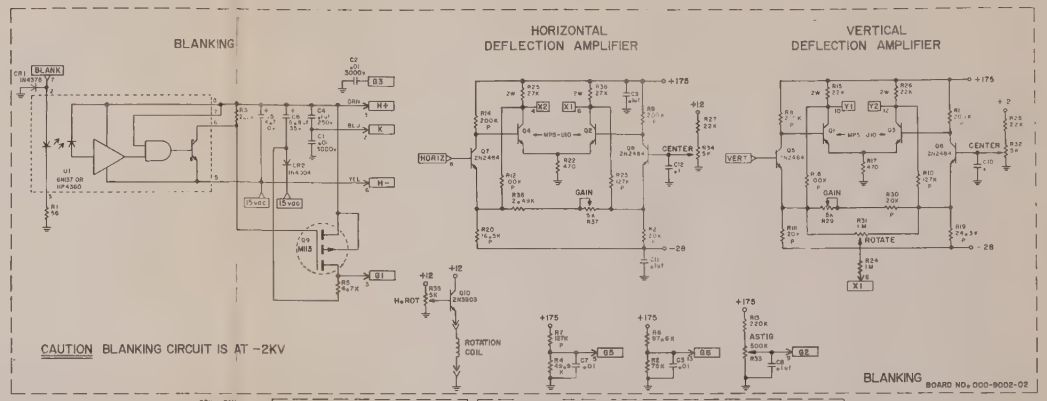
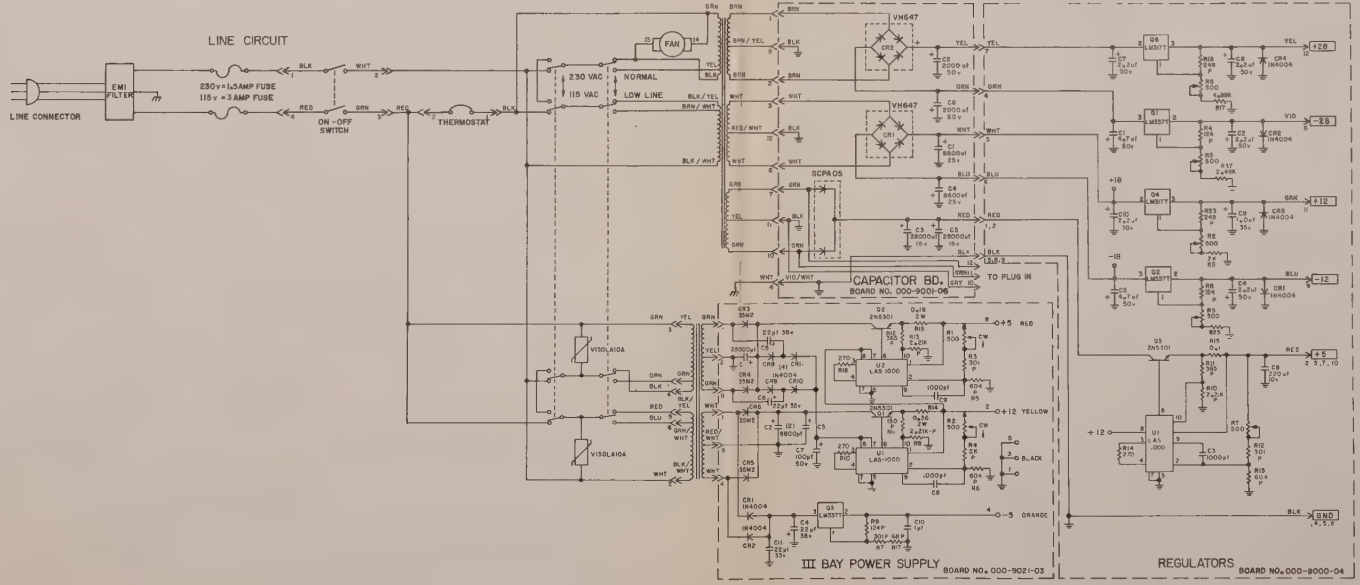
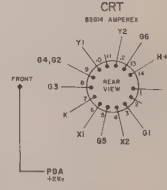
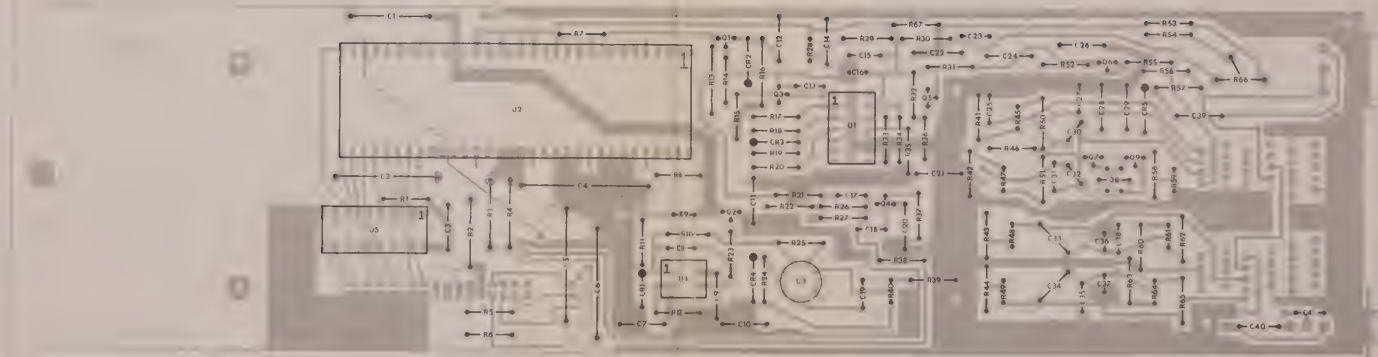








NICOLET INSTRUMENT CORP
POWER SUPPLY, BLANKING & LINE CIRCUIT
LEK 11-30-79



204-A PLUG-IN DIGITIZER BOARD
- COMPONENT SIDE -

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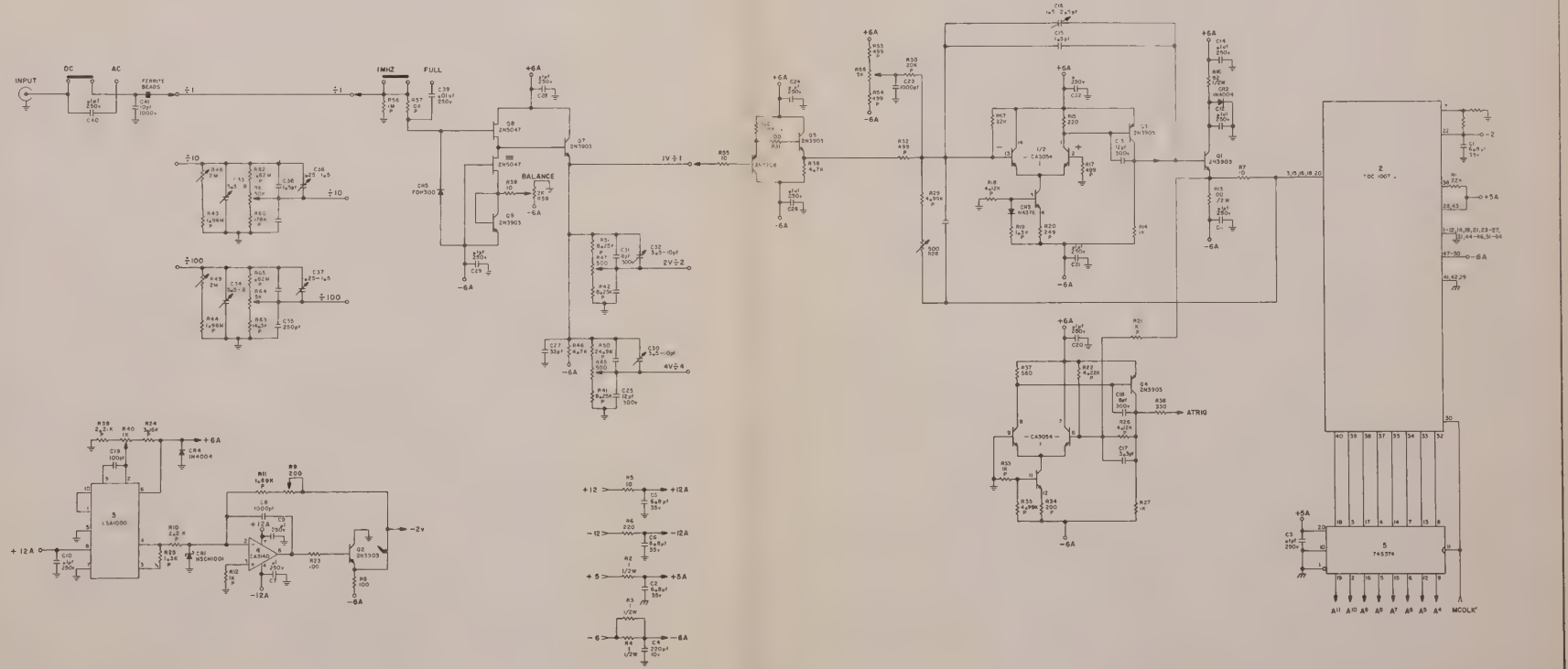
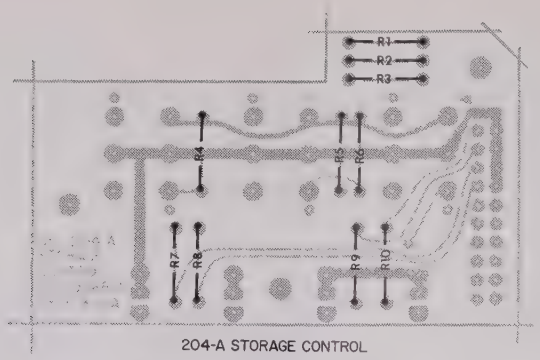


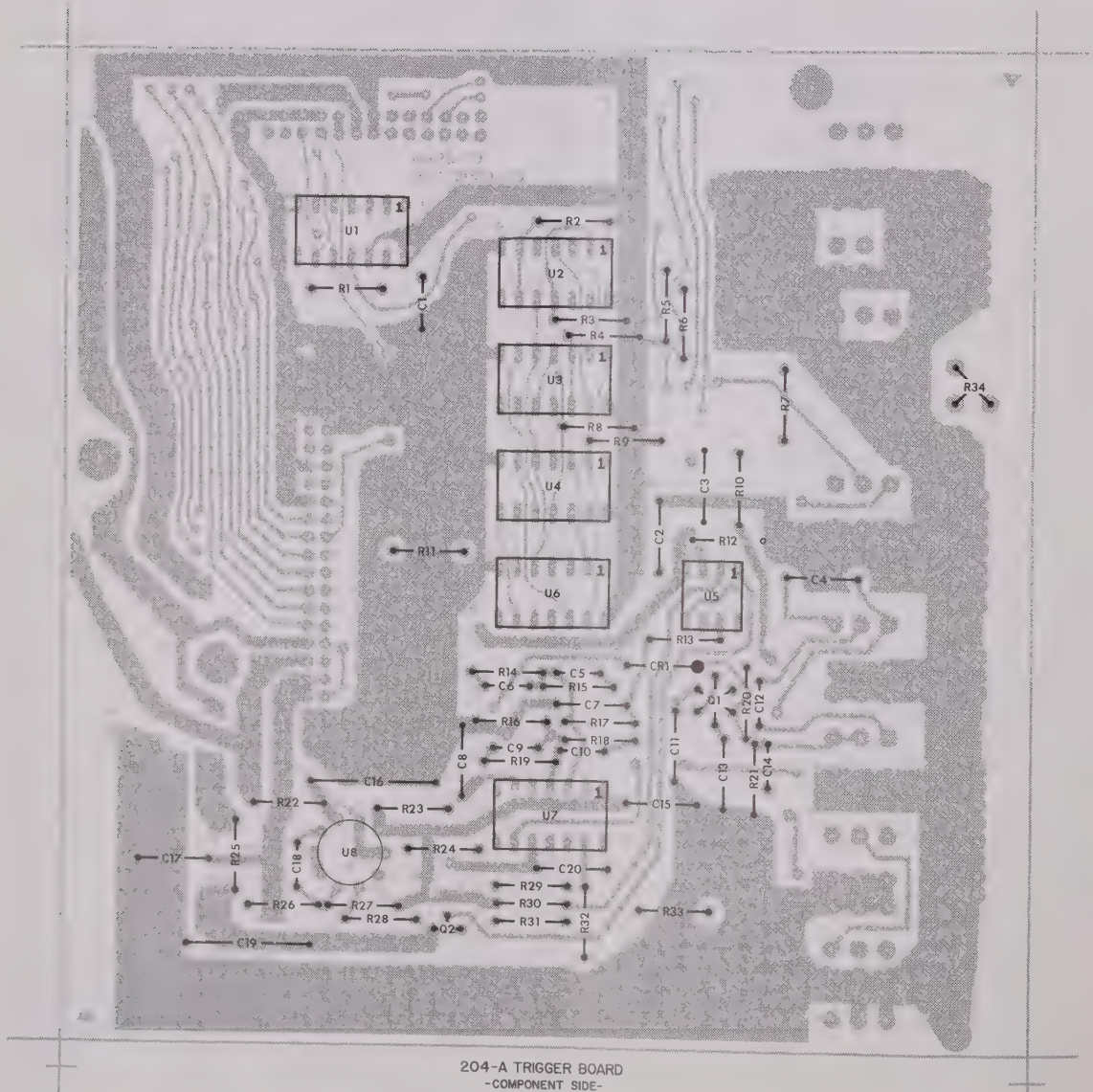
33	31	29	27	25	23	21	19	17	15	13	11	9	7	5	3	1
GND	GND	GND	GND	GND	GND	GND	GND	-12	-6	-6	+12	+5	AN2	AN3	AN6	MCLK'
A4	A5	A6	A7	A8	A9	A10	A11	-12	-6	-6	+12	+5	AN8	ATRIG	GND	GND
34	32	30	28	26	24	22	20	18	16	14	12	10	8	6	4	2

(CHANNEL B CONNECTOR IS THE SAME PINOUT —— REPLACE A's WITH B's)

NICOLET INSTRUMENT CORP		
204-A PLUG-IN DIGITIZER BOARD		
000-9063-02	LBK	11-20-79



204-A STORAGE CONTROL
-CONDUCTOR SIDE-



204-A TRIGGER BOARD
-COMPONENT SIDE-

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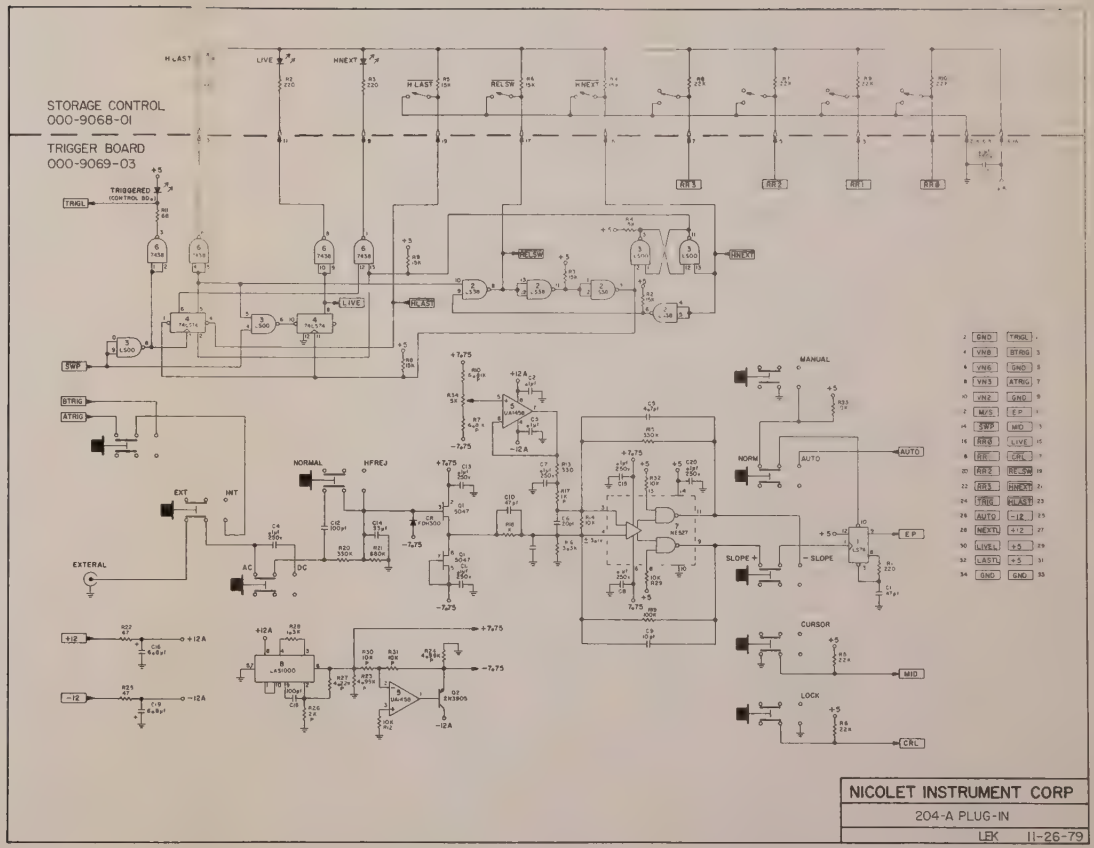
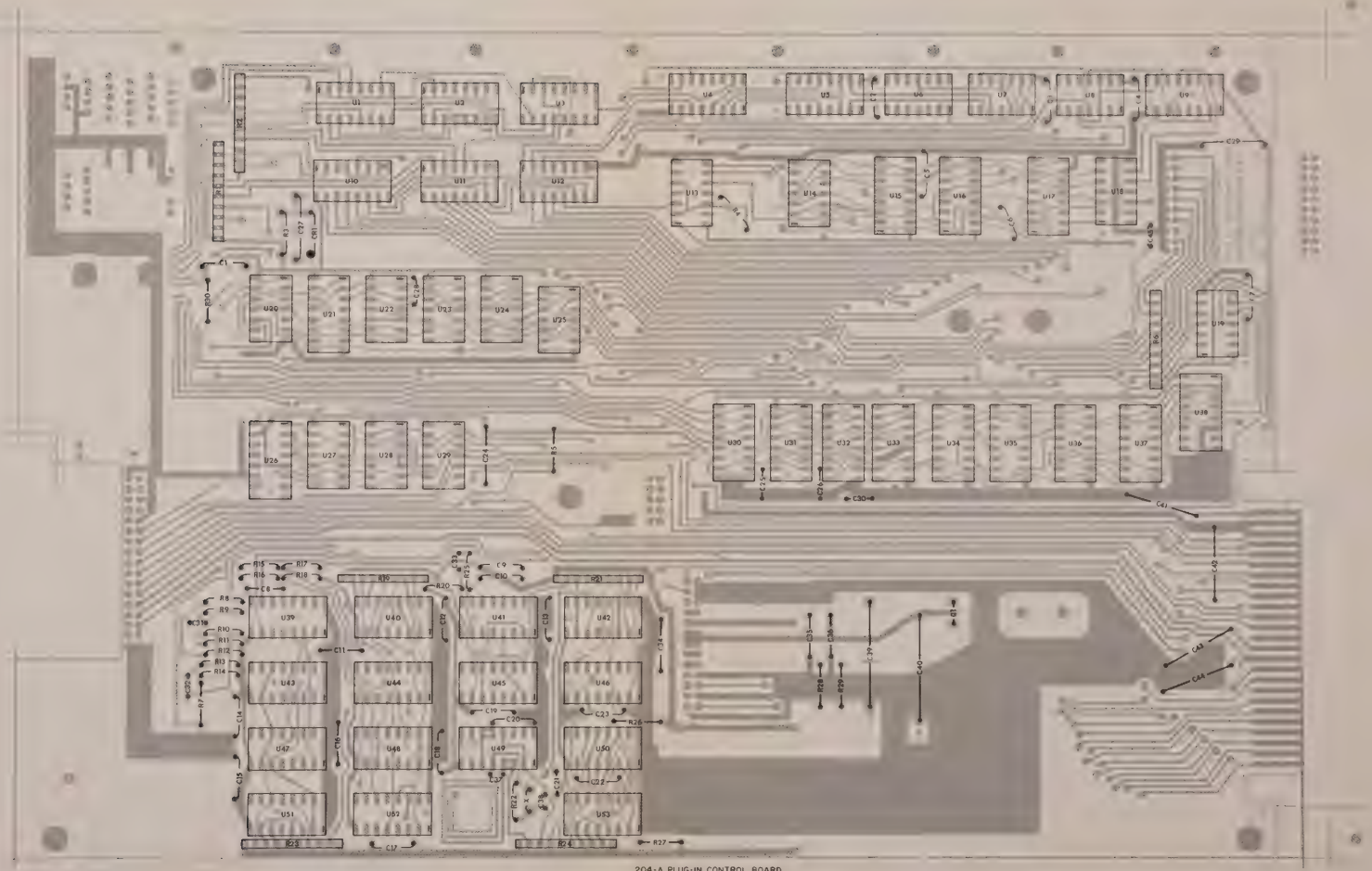


NICOLET INSTRUMENT CORP
204-A PLUG-IN
LEK 11-26-79



204-A PLUG-IN CONTROL BOARD
- CONDUCTOR SIDE -

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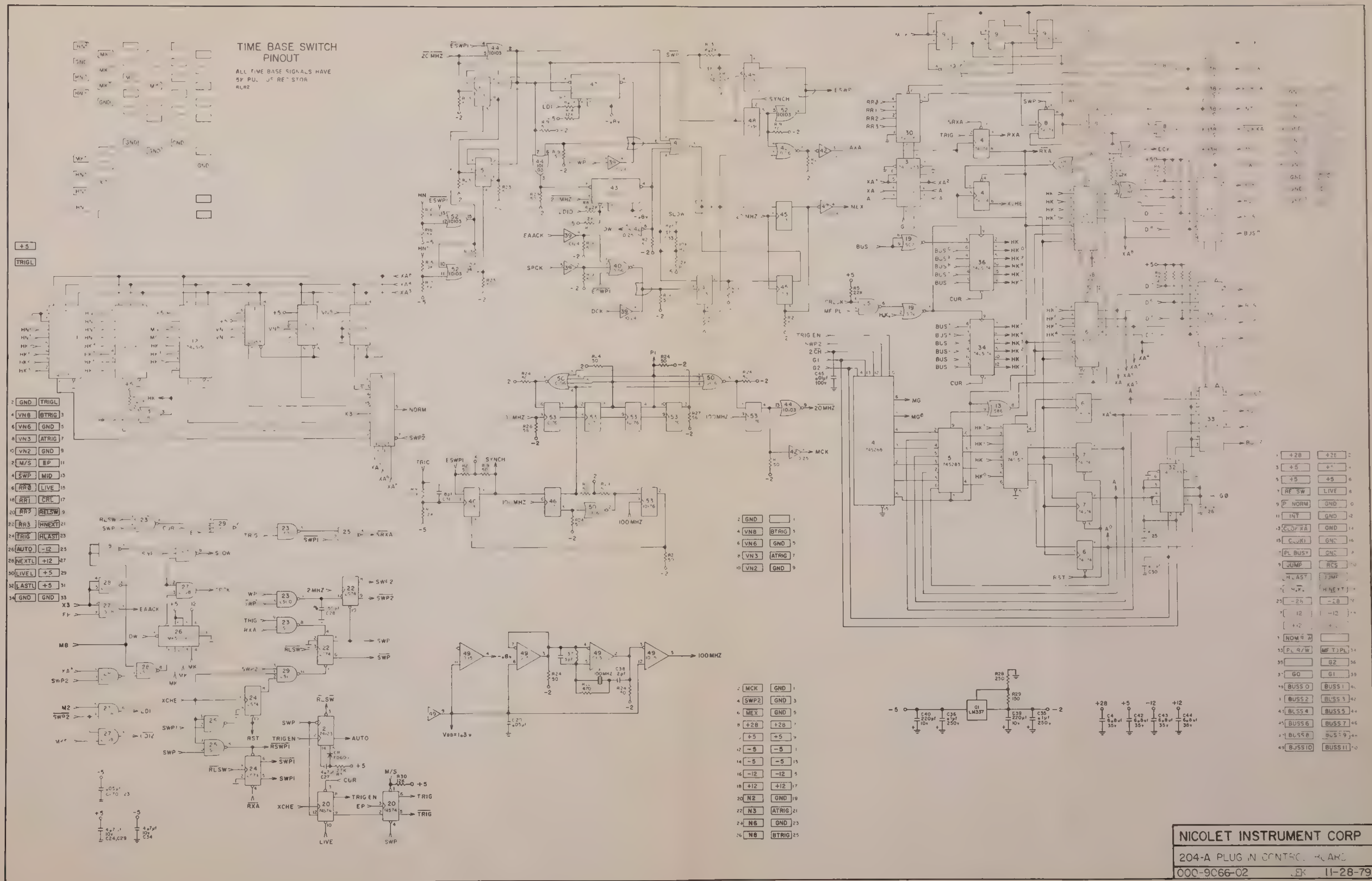
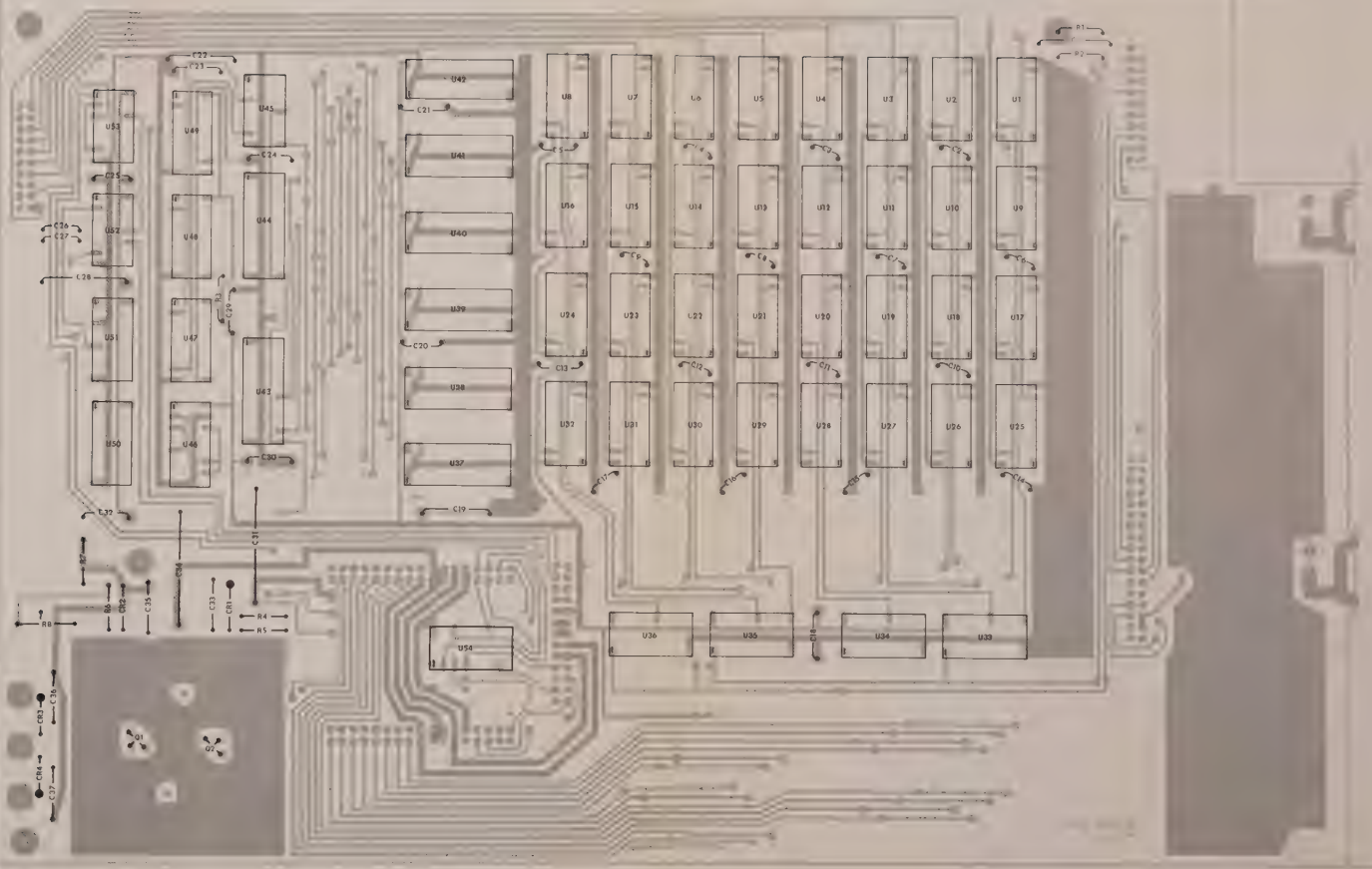

TIME BASE SWITCH PINOUT
ALL TIME BASE SIGNALS HAVE
100MHZ
20MHZ
MCK
NORM
AUTO
TRIG
NICOLET INSTRUMENT CORP
204-A PLUG IN CONTROL BOARD
000-9066-02
11-28-79



204-A PLUG IN MEMORY BOARD
— COMPONENT SIDE —

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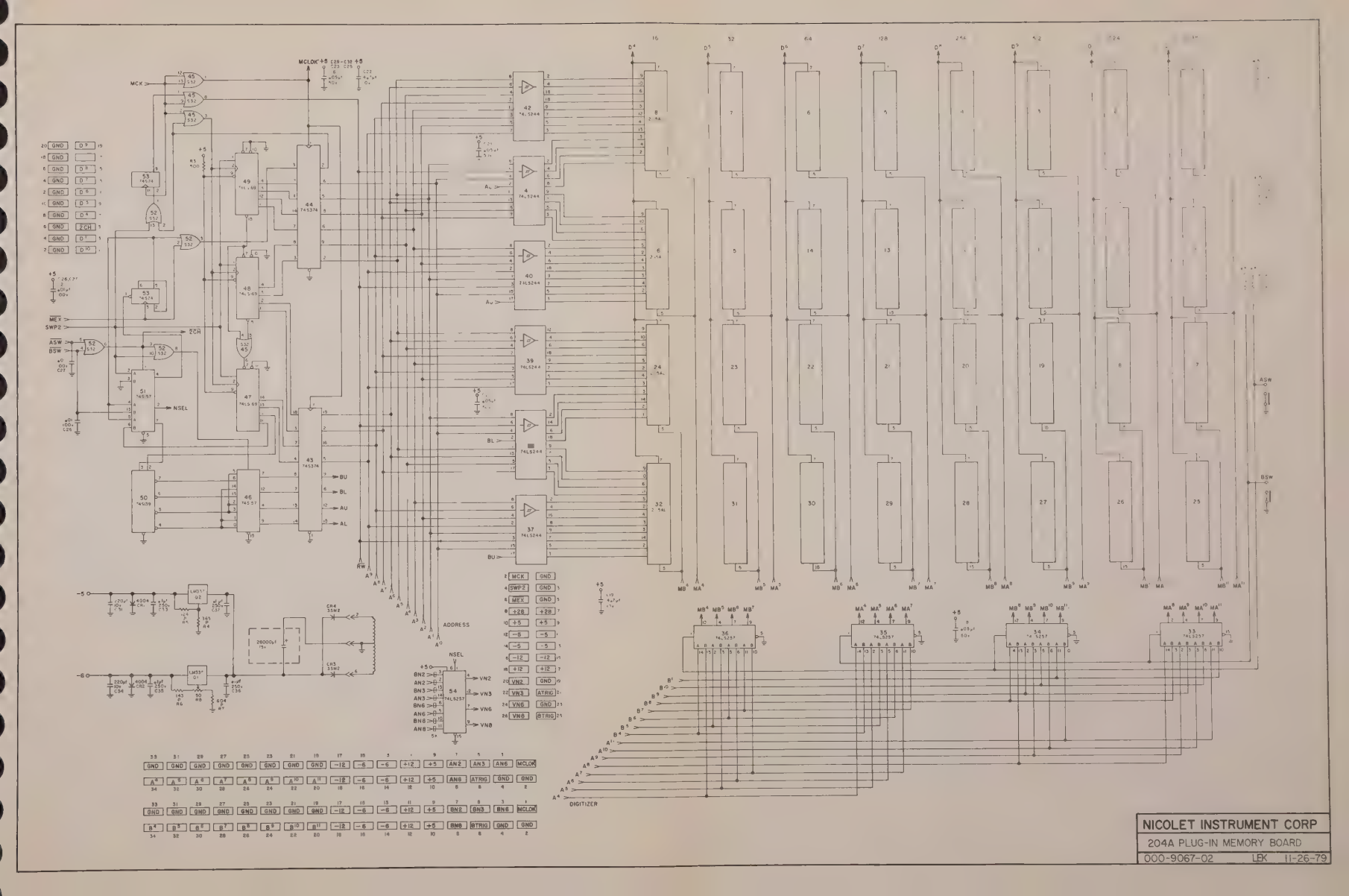
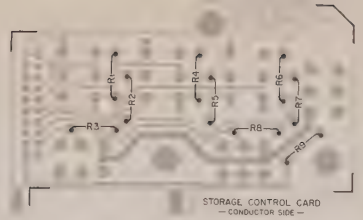


NICOLET INSTRUMENT CORP		
204A PLUG-IN MEMORY BOARD		
000-9067-02	LEK	11-26-79



STORAGE CONTROL CARD
— CONDUCTOR SIDE —

206 PLUG-IN CONTROL BOARD
— CONDUCTOR SIDE —

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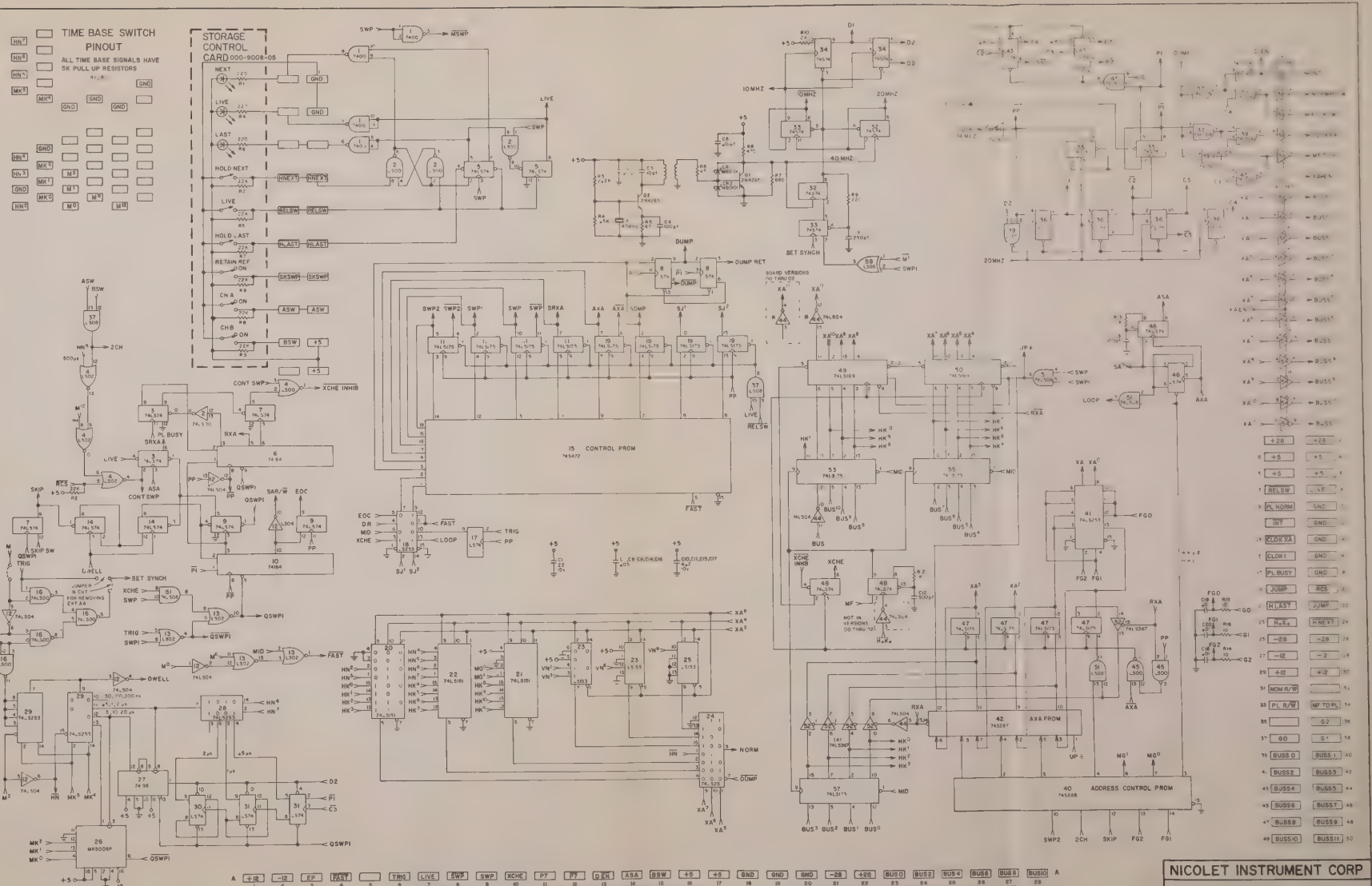
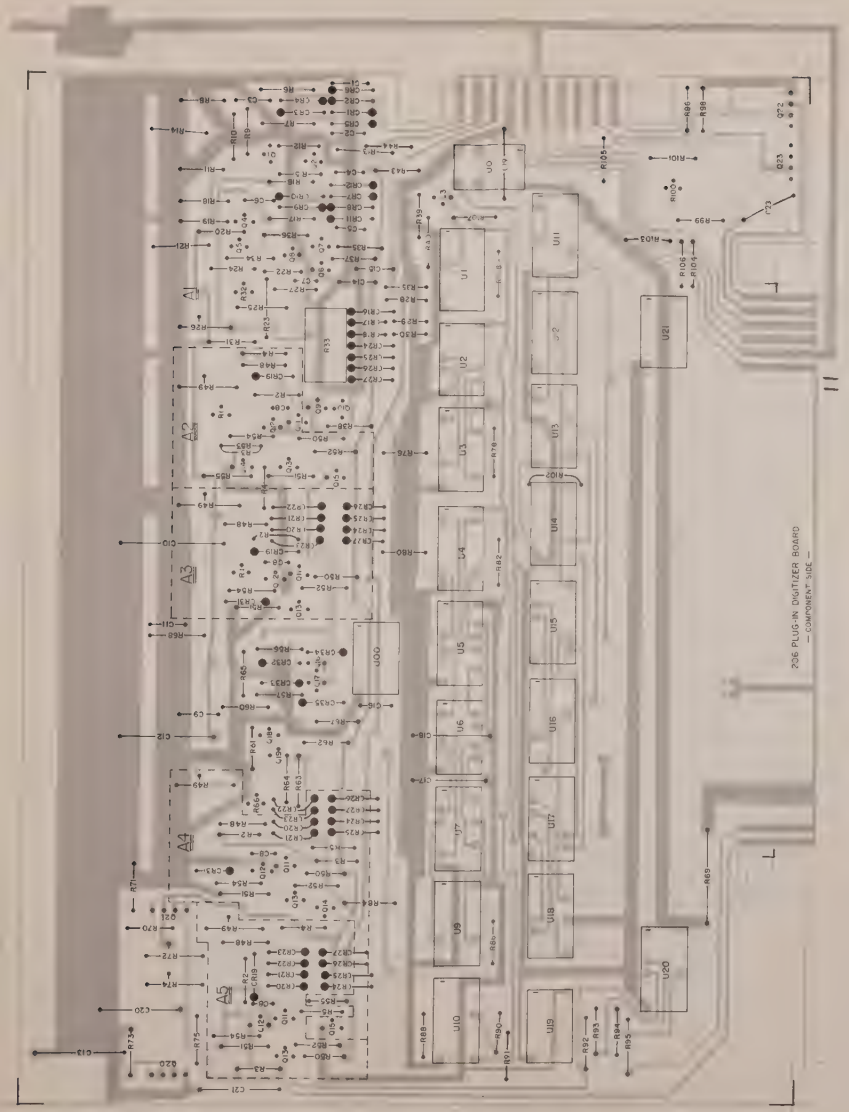
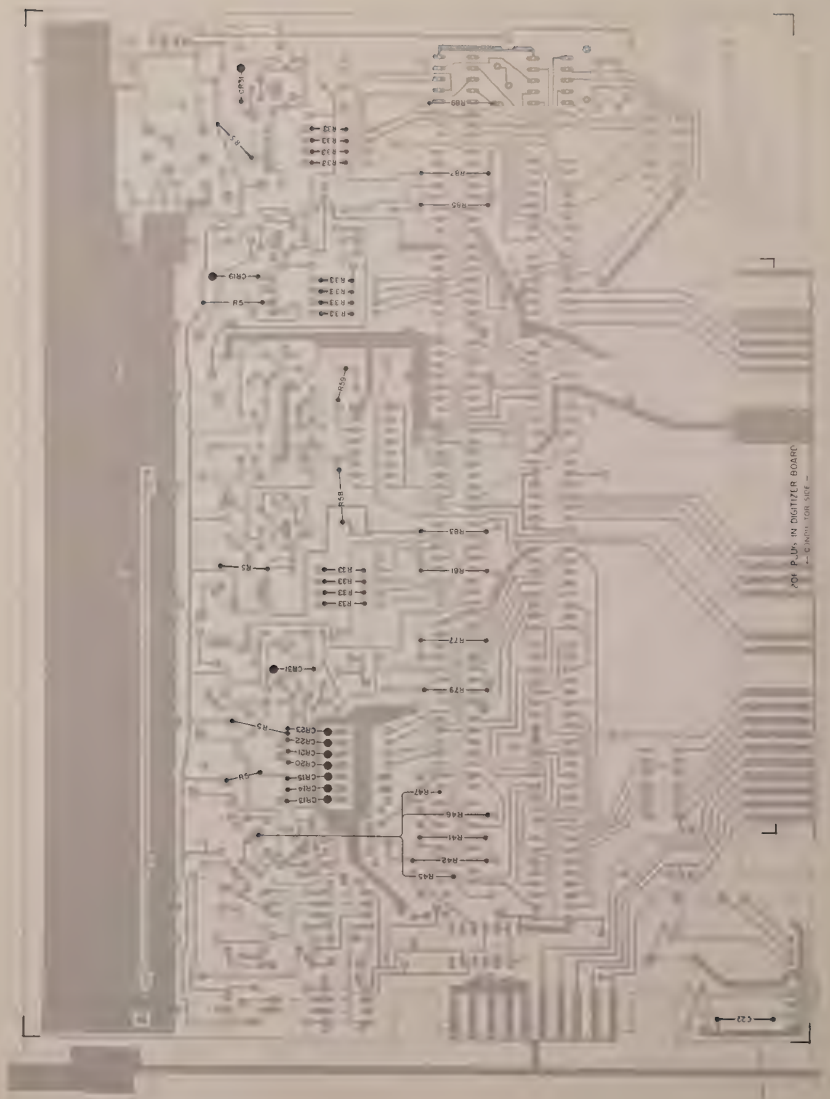


A	+12	-12	EP	FAST		TRIG	LIVE	SWP	SWP	XCHE	P7	P7	Q EN	ASA	BSW	+5	+5	GND	GND	GND	-28	+28	BUS 0	BUS 2	BUS 4	BUS 6	BUS 8	BUS 10	A
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28		
B	+12	-12	M	N2	N6	N3	N8	RELSW	MID	P4	LOAD	SWP2	SA^00	SAR/W	ASW	+5	+5	GND	GND	GND	-28	+28	BUS 1	BUS 3	BUS 5	BUS 7	BUS 9	BUS 11	B

* NOTE! ON VERSIONS 00 THRU 02, FAST IS ON PIN 85, A4 IS NOT USED

NICOLET INSTRUMENT CORP	
206 PLUG-IN CONTROL BOARD	
000-9012-07	LEK 12-4-79





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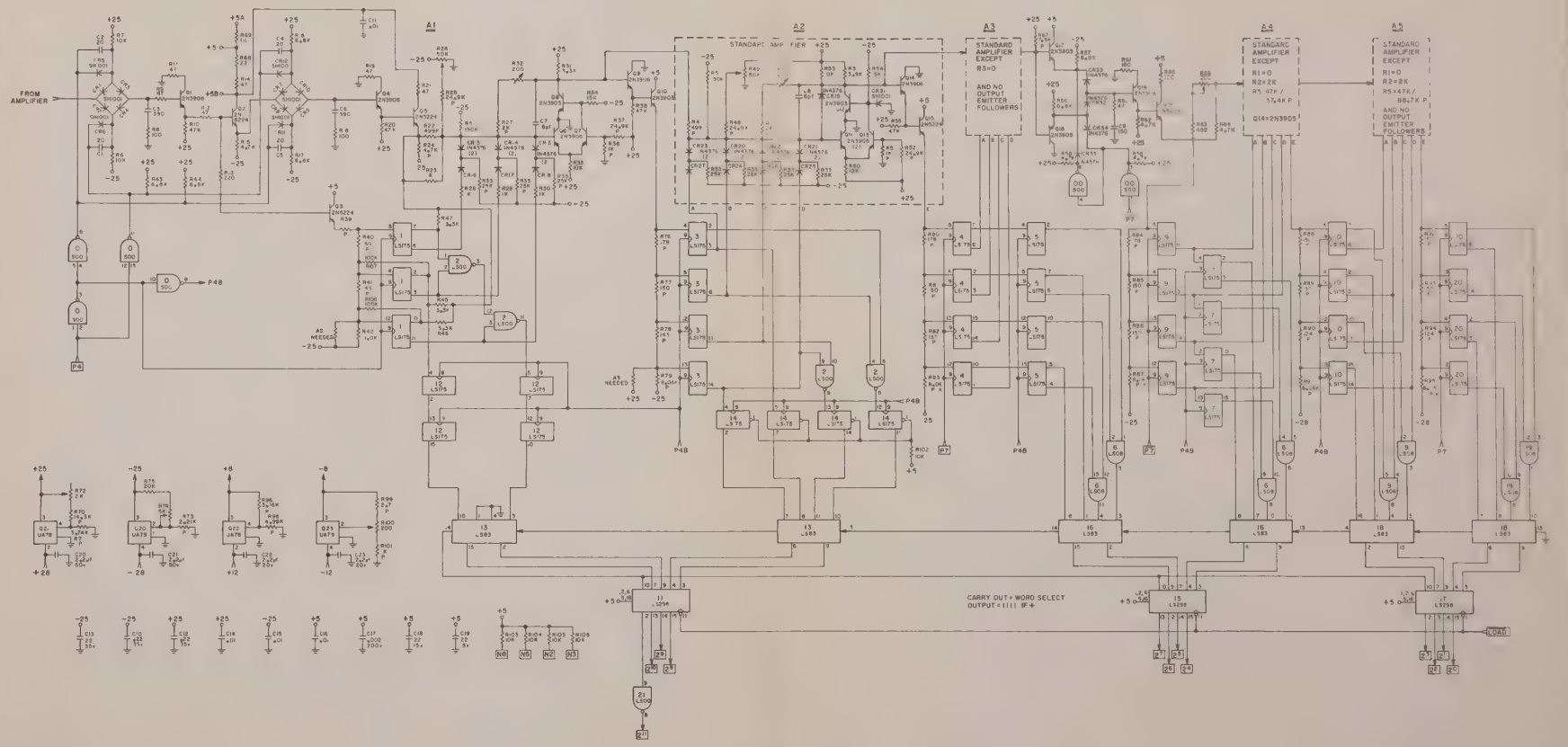
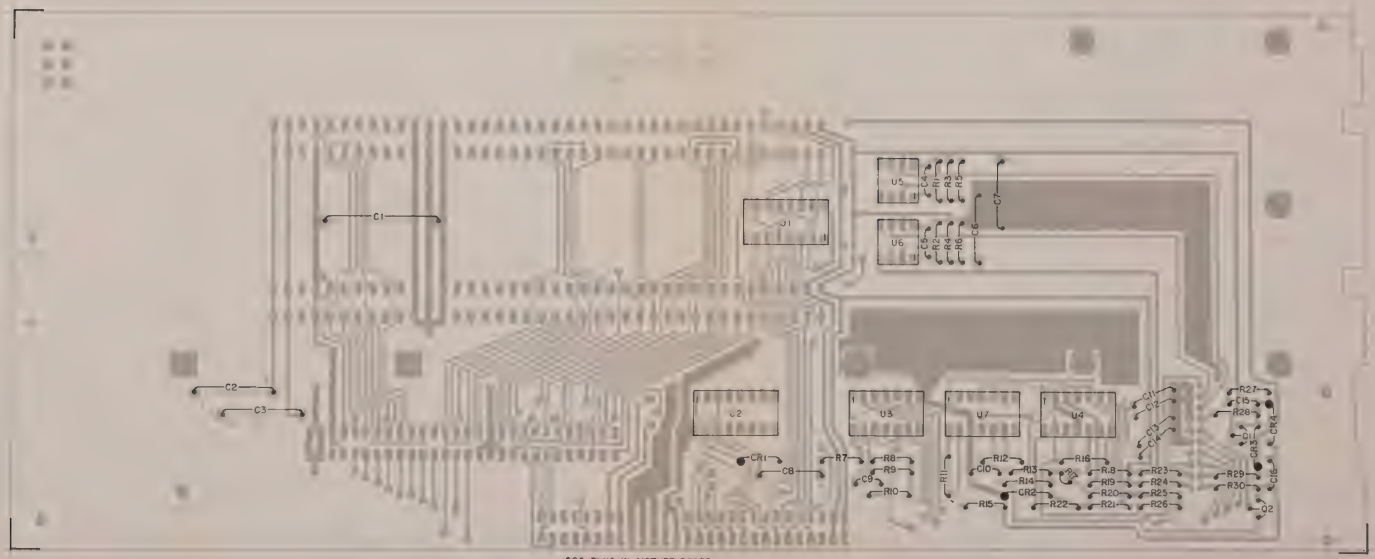


NICOLET INSTRUMENT CORP		
206 PLUG-IN DIGITIZER BOARD		
000-9009-05	LEK	12-4-79



206 PLUG-IN MOTHER BOARD
— CONDUCTOR SIDE —

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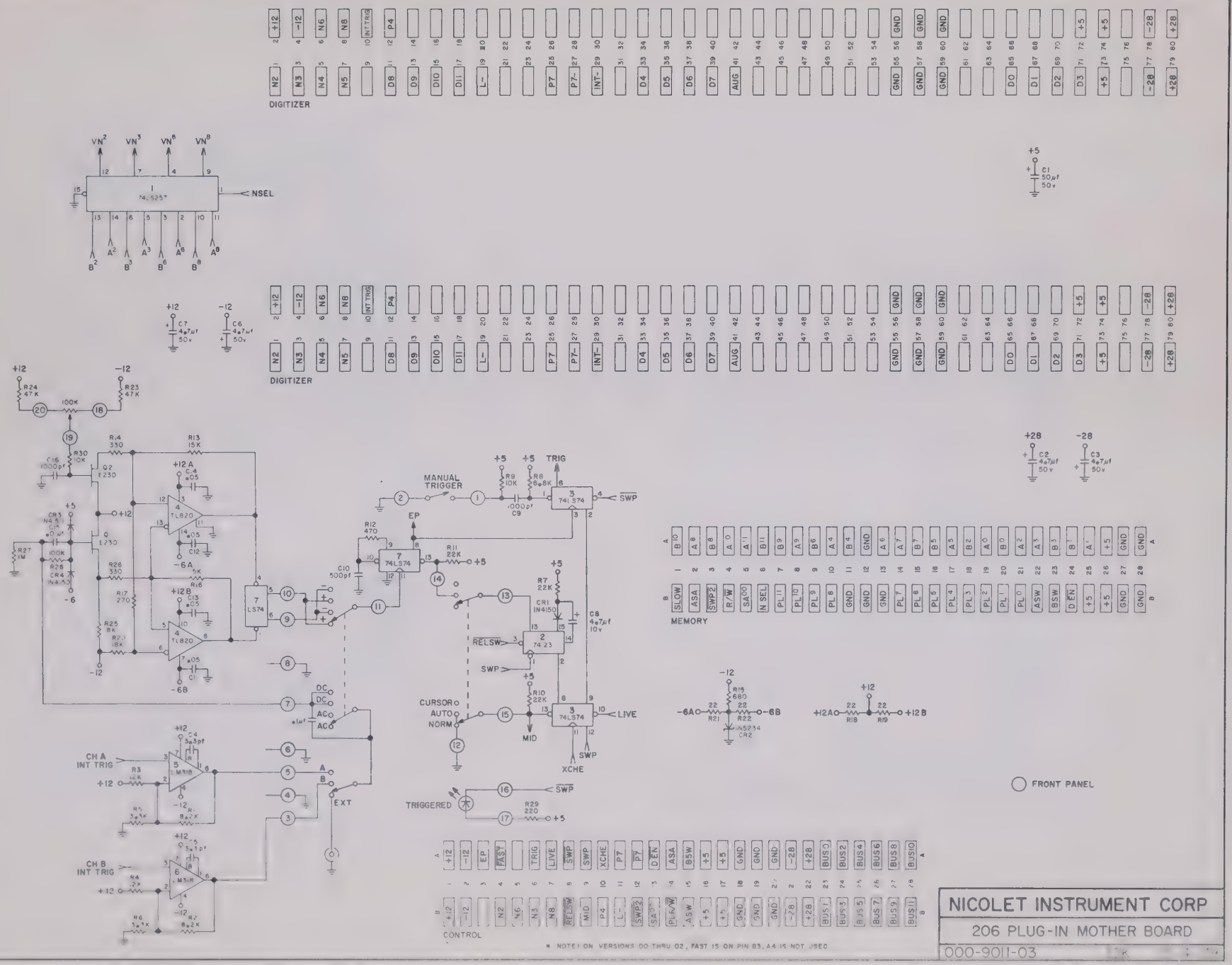
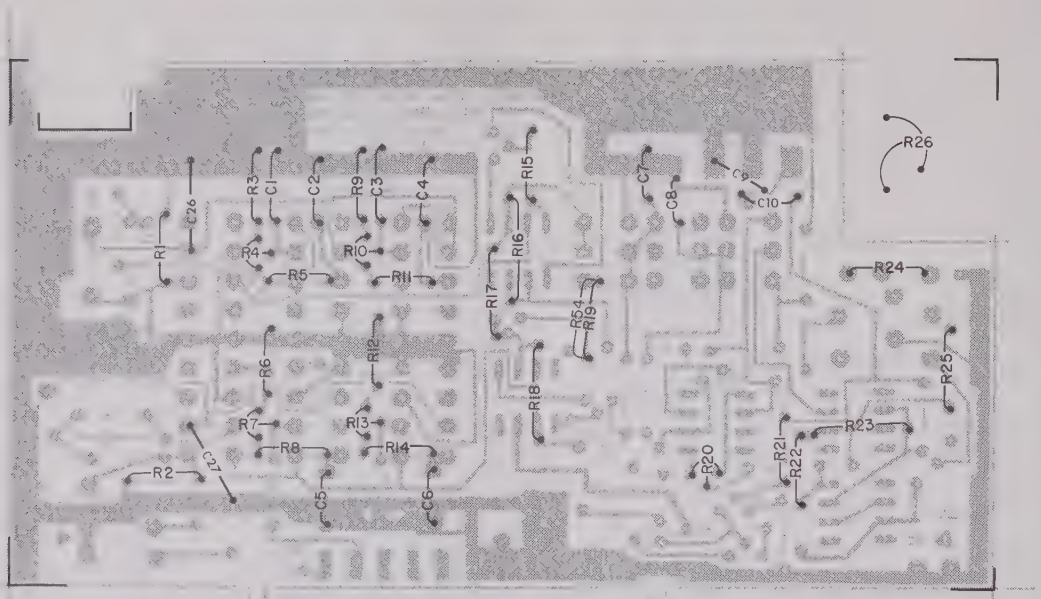
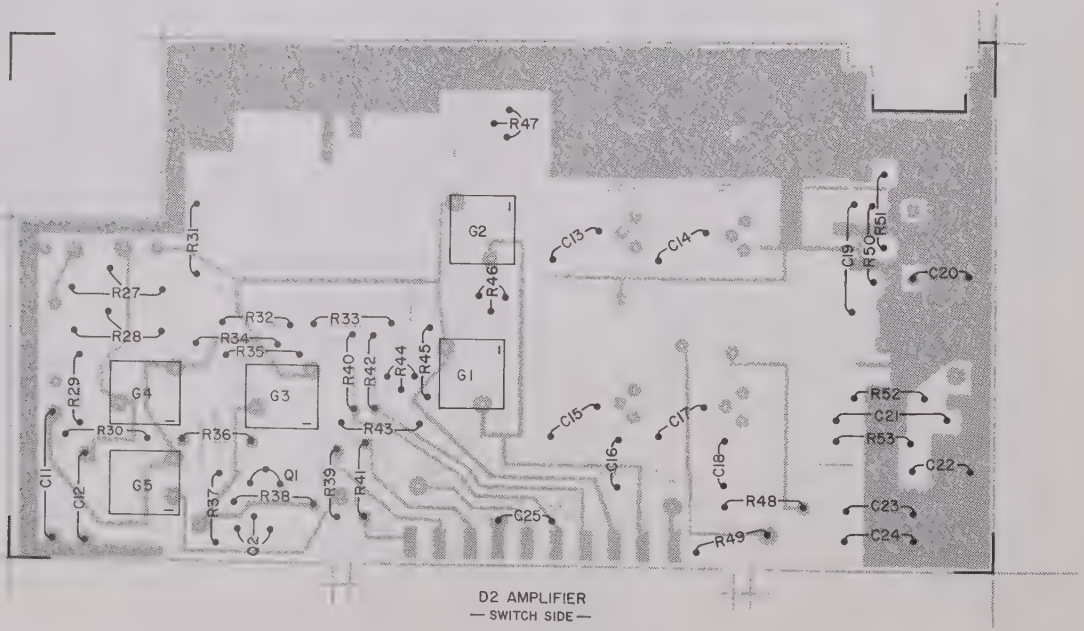

DIGITIZER
MEMORY
CONTROL
FRONT PANEL
MANUAL TRIGGER
TRIGGERED
CH A INT TRIG
CH B INT TRIG
NSEL
74LS257
74LS74
74LS74
74LS74
74LS74
74LS23
TL820
TL820
LS74
LM318
LM318
CURSOR
AUTO
NORM
MID
XCHE
LIVE
SWP
TRIG
EP
RELSW
EXT
* NOTE: ON VERSIONS 00 THRU 02, FAST IS ON PIN B3, A4 IS NOT USED
NICOLET INSTRUMENT CORP
206 PLUG-IN MOTHER BOARD
000-9011-03



D2 AMPLIFIER
— CONDUCTOR SIDE —



D2 AMPLIFIER
— SWITCH SIDE —

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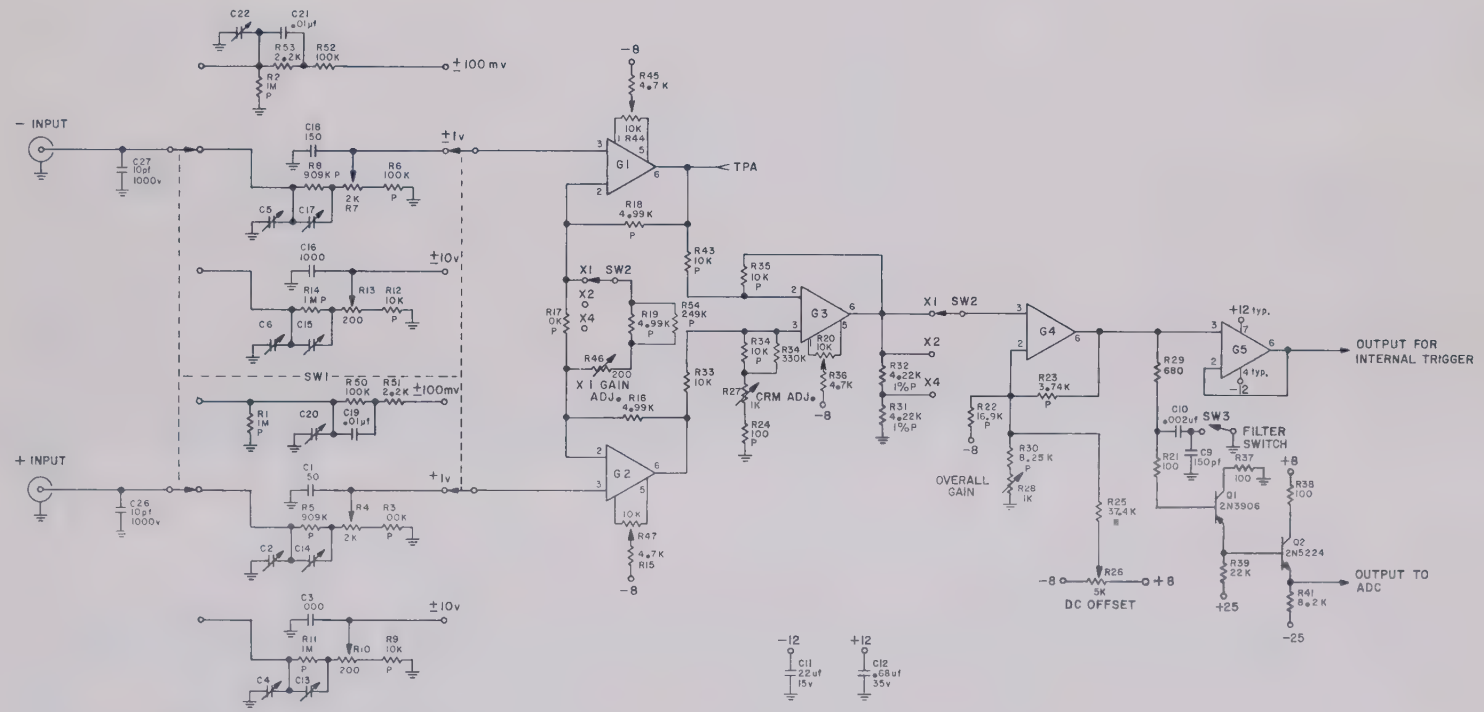
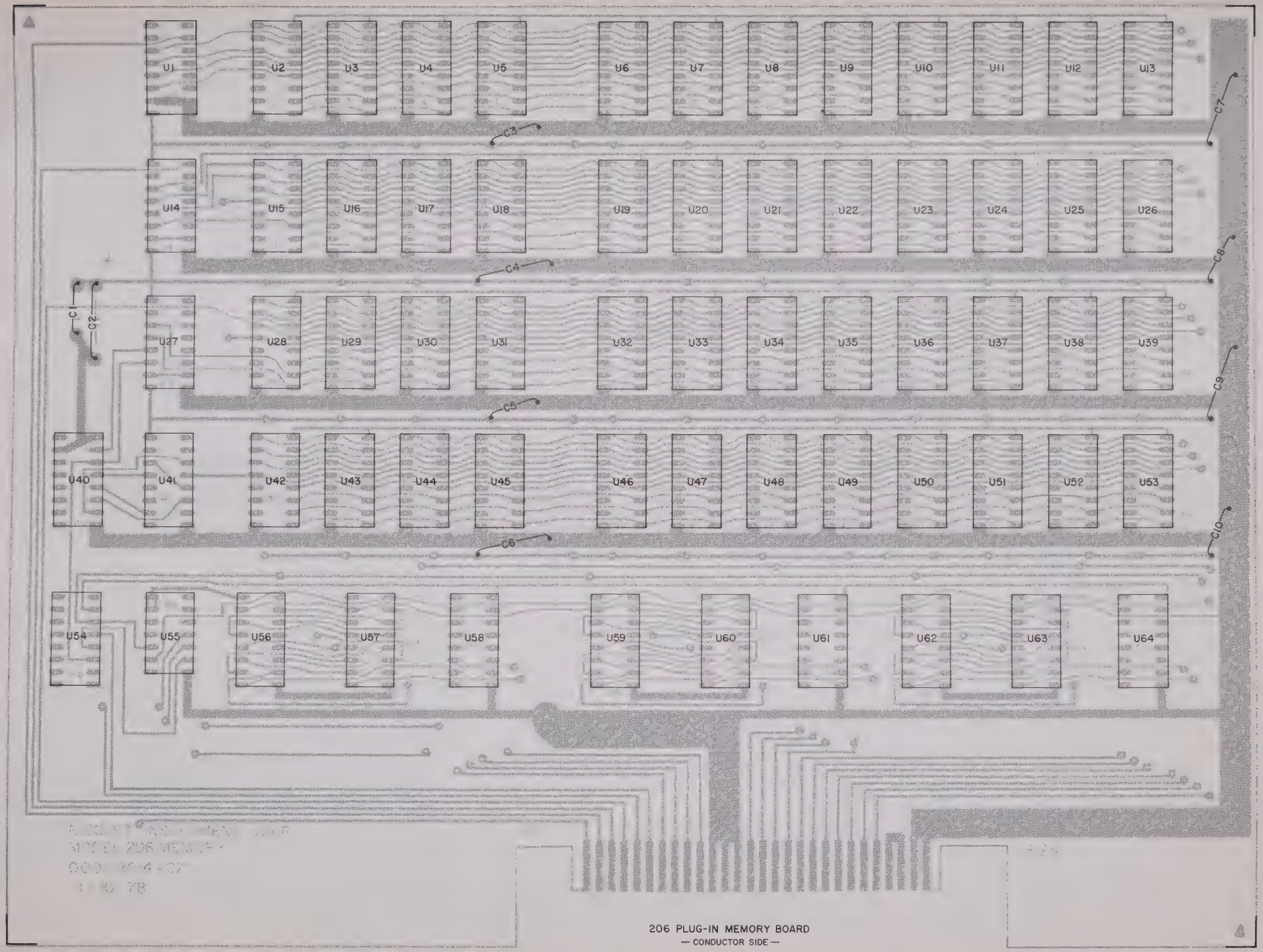


NICOLET INSTRUMENT CORP

D2 AMPLIFIER



206 PLUG-IN MEMORY BOARD

— CONDUCTOR SIDE —

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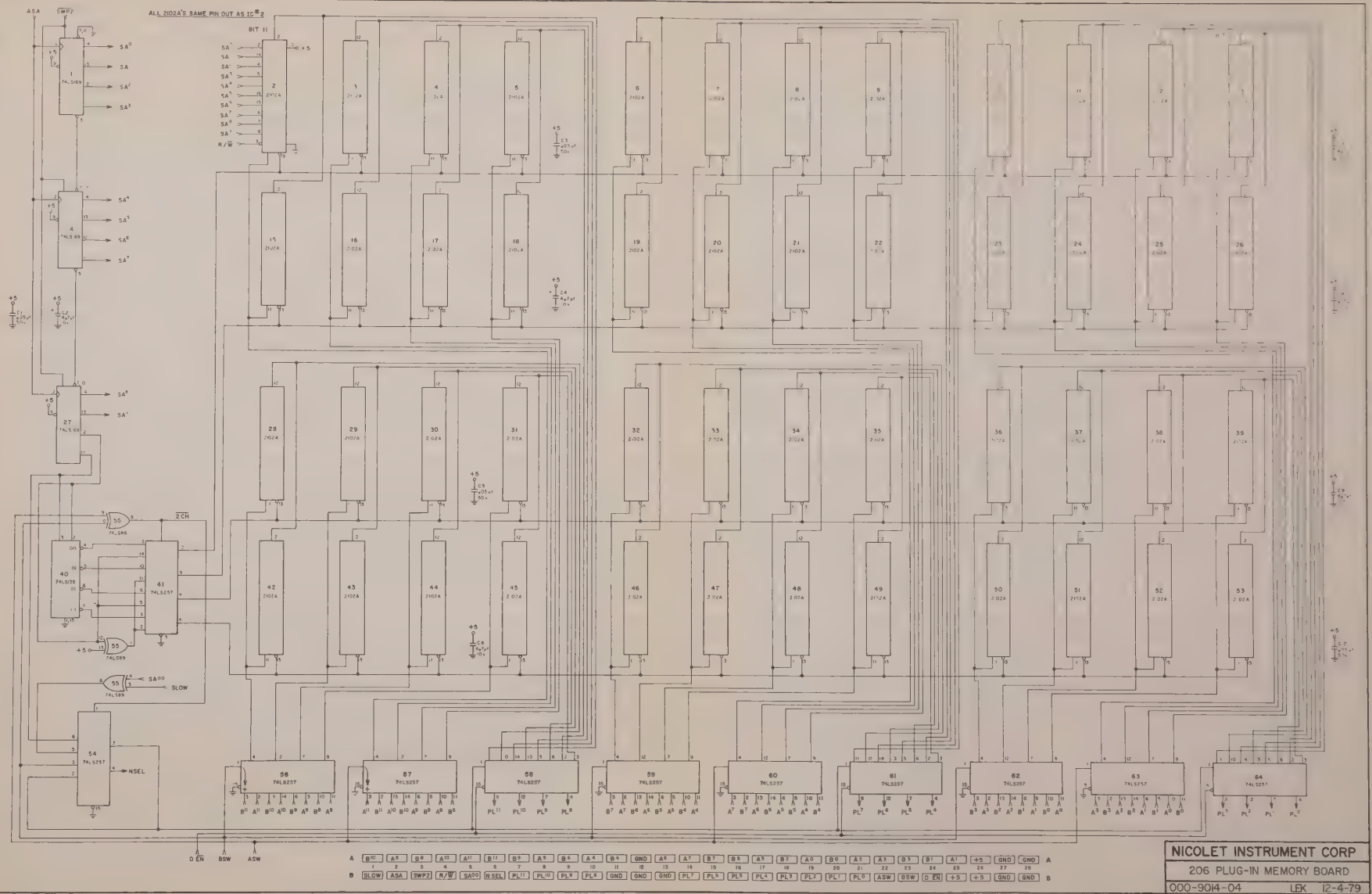
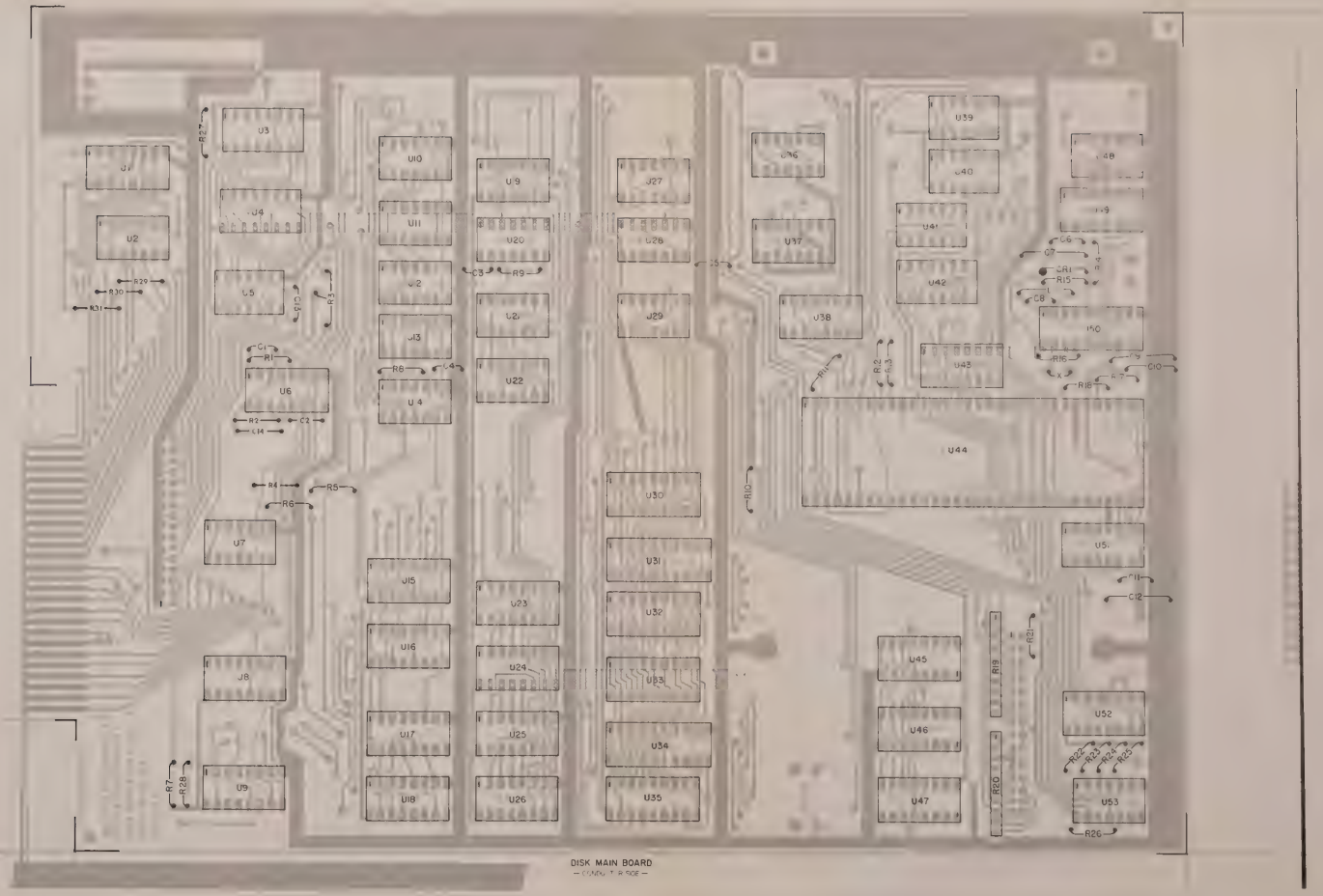

ALL 2102A'S SAME PIN OUT AS IC #2
BIT 11
ASA
SWP2
2CH
SLOW
NSEL
D EN
BSW
ASW
NICOLET INSTRUMENT CORP
206 PLUG-IN MEMORY BOARD
000-9014-04
LEK 12-4-79



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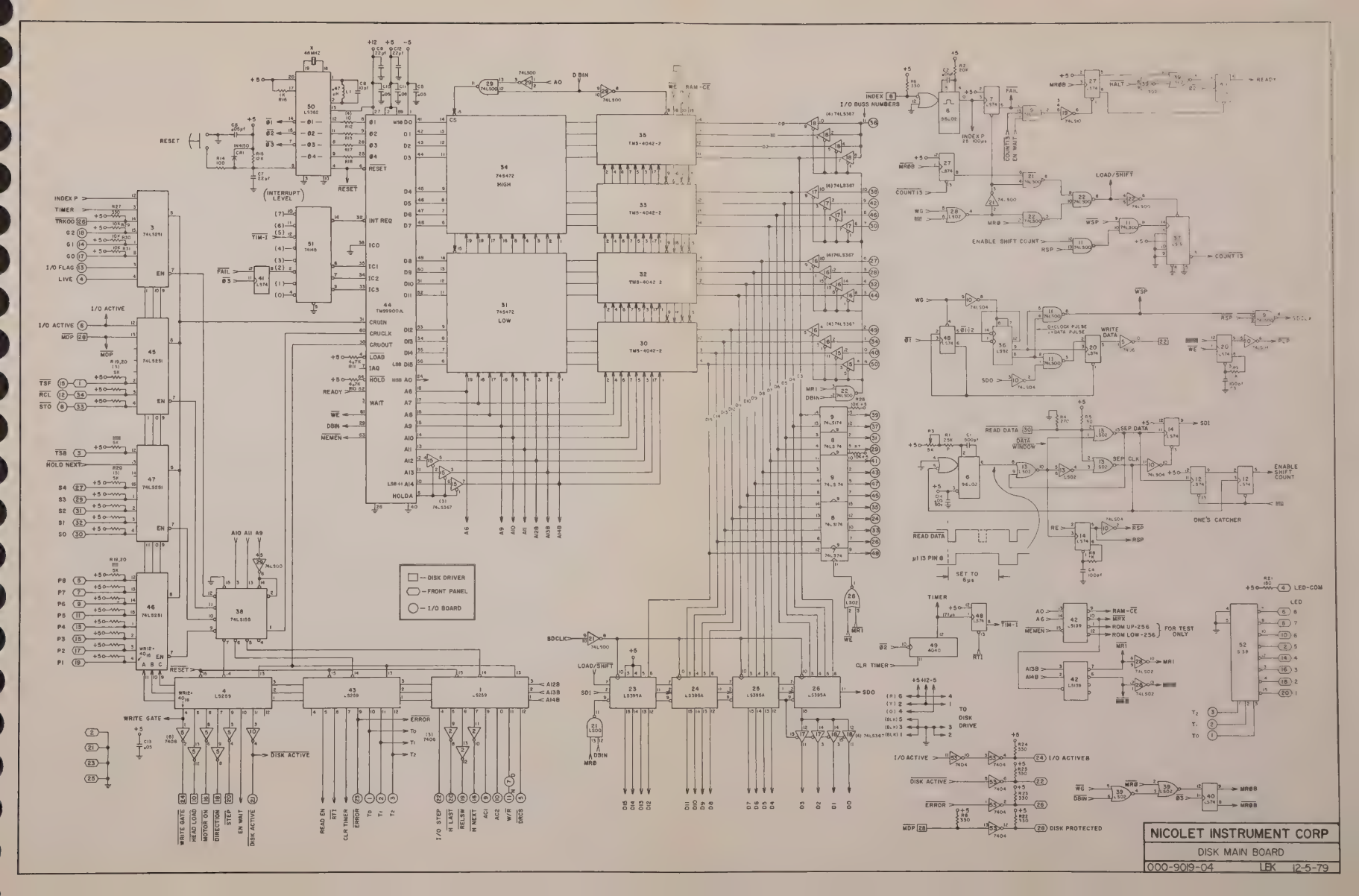
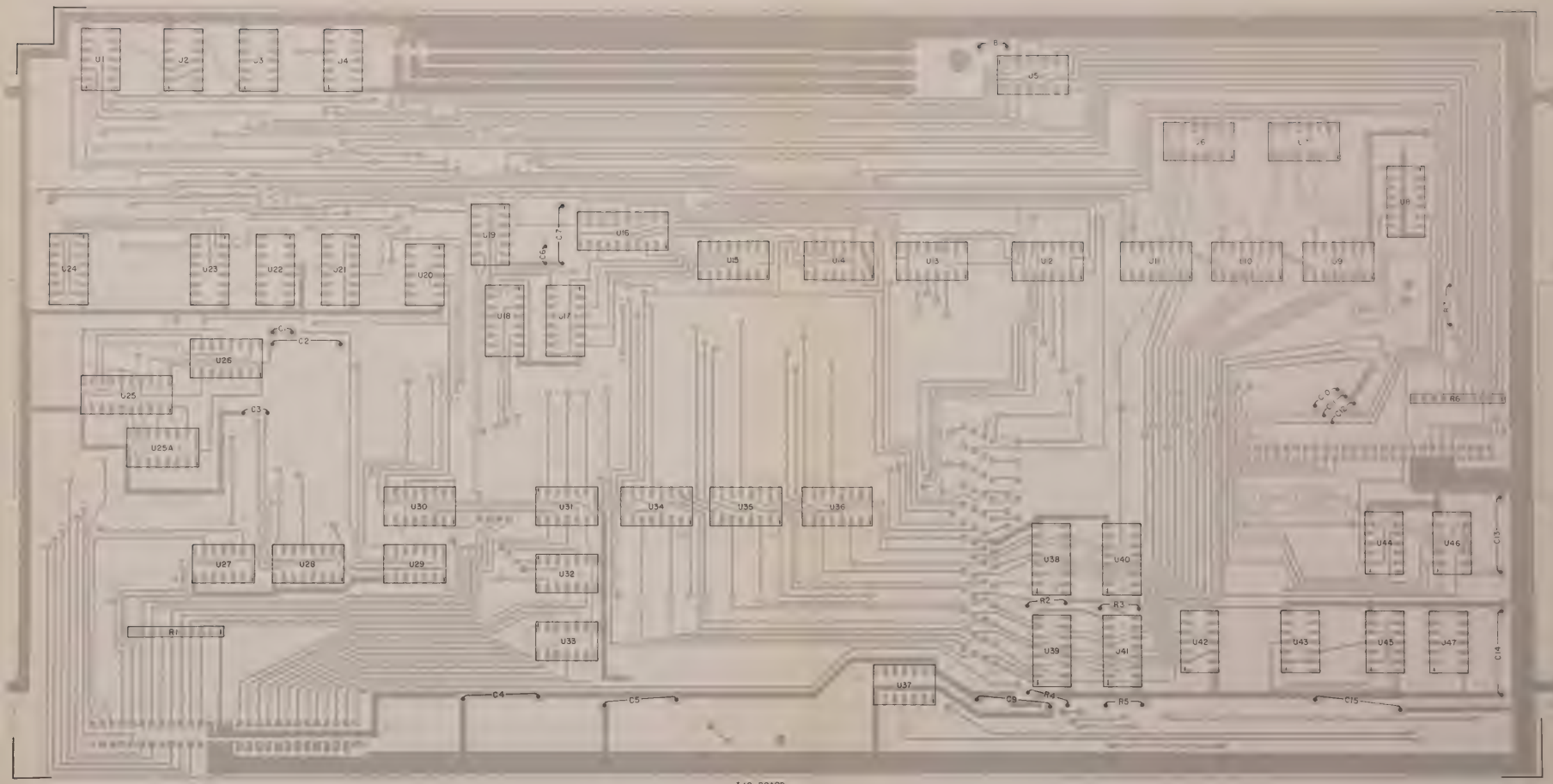

NICOLET INSTRUMENT CORP
DISK MAIN BOARD
000-9019-04 LBK 12-5-79



I/O BOARD
— CONDUCTOR SIDE —

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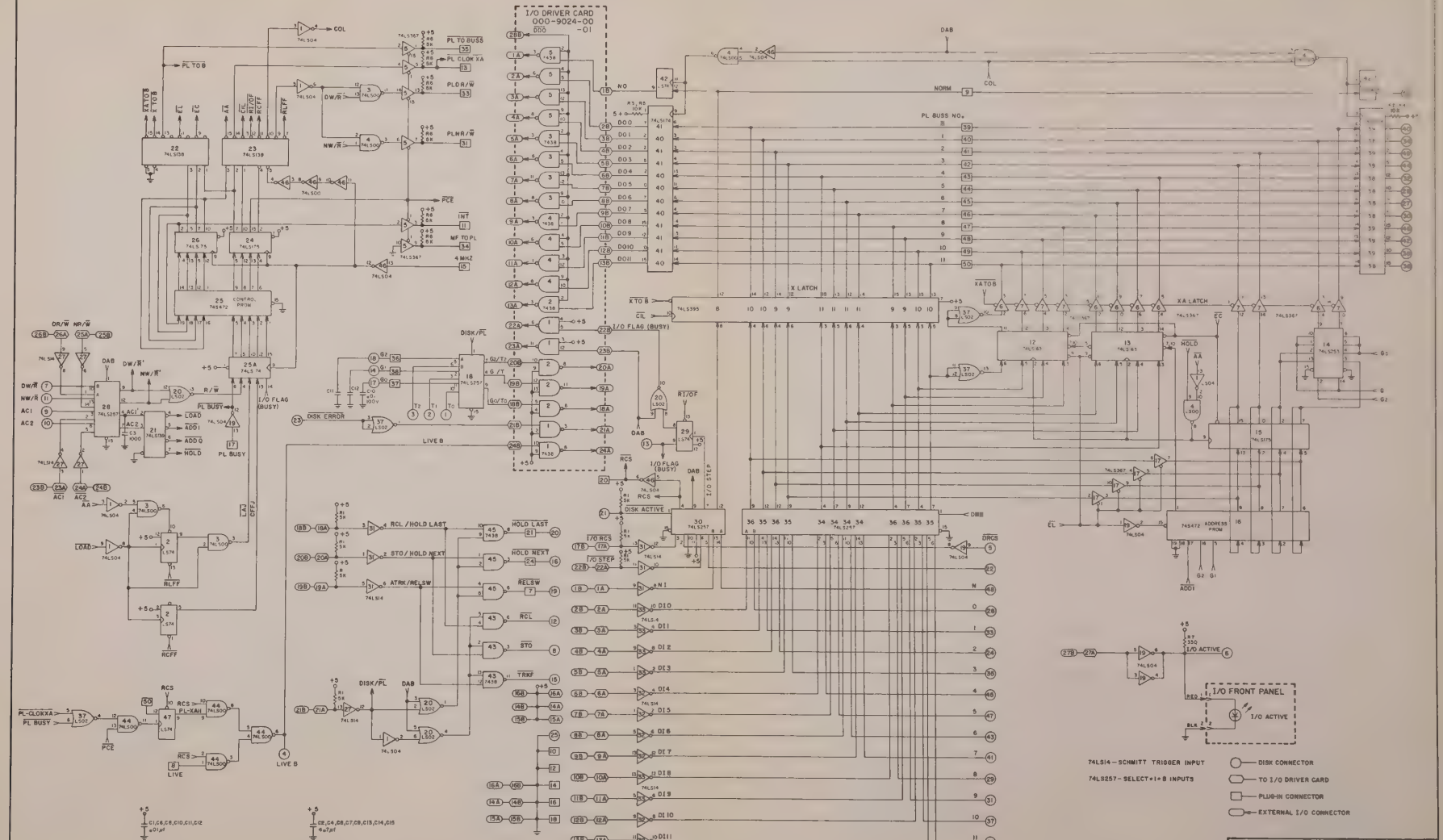
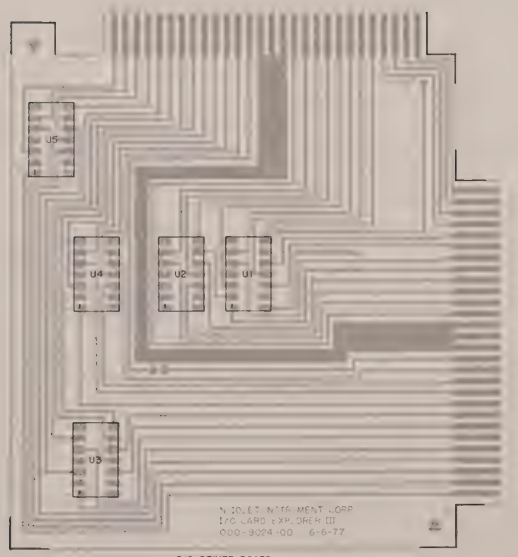


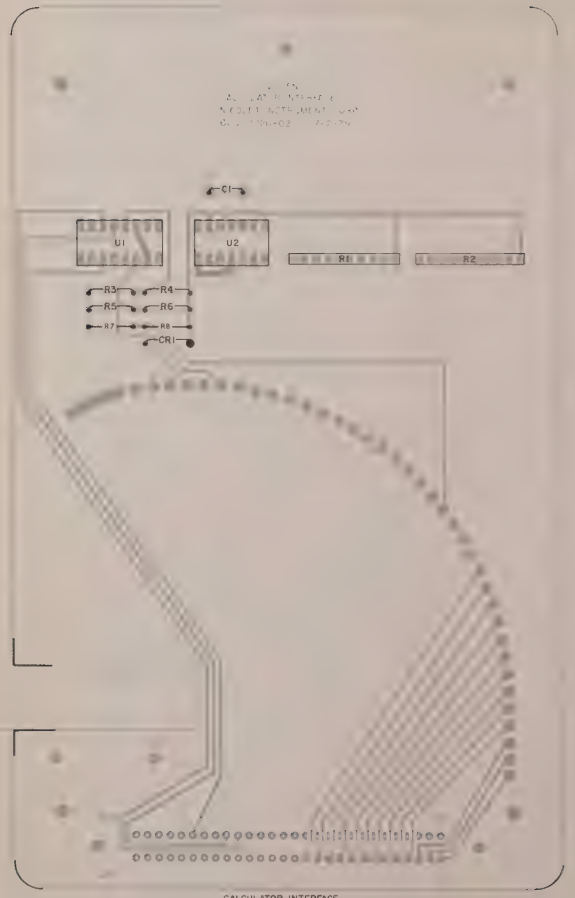
NICOLET INSTRUMENT CORP

I/O BOARDS

000-9022-05 LBK 9-26-78



I/O DRIVER BOARD
— CONDUCTOR SIDE —



CALCULATOR INTERFACE

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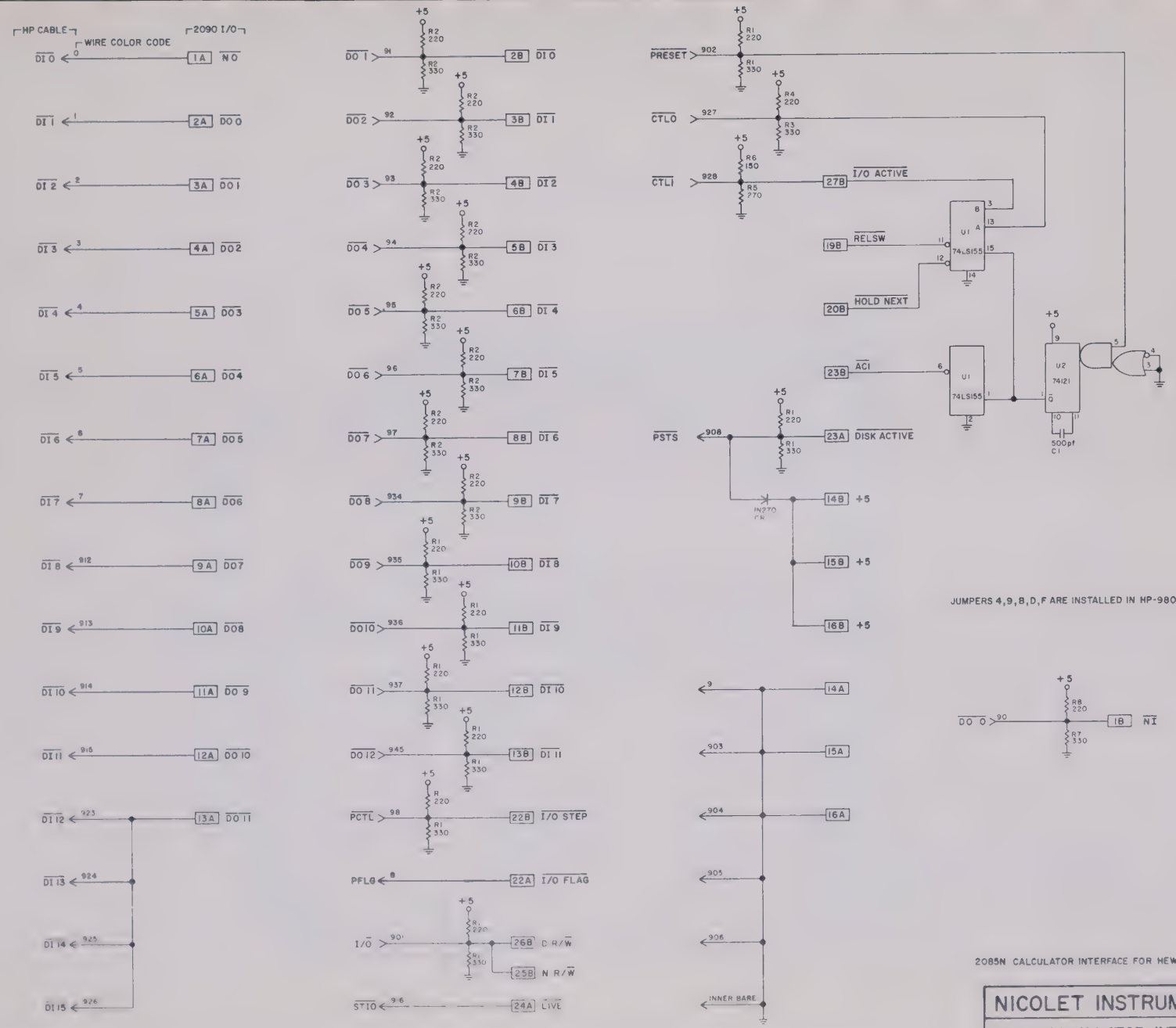
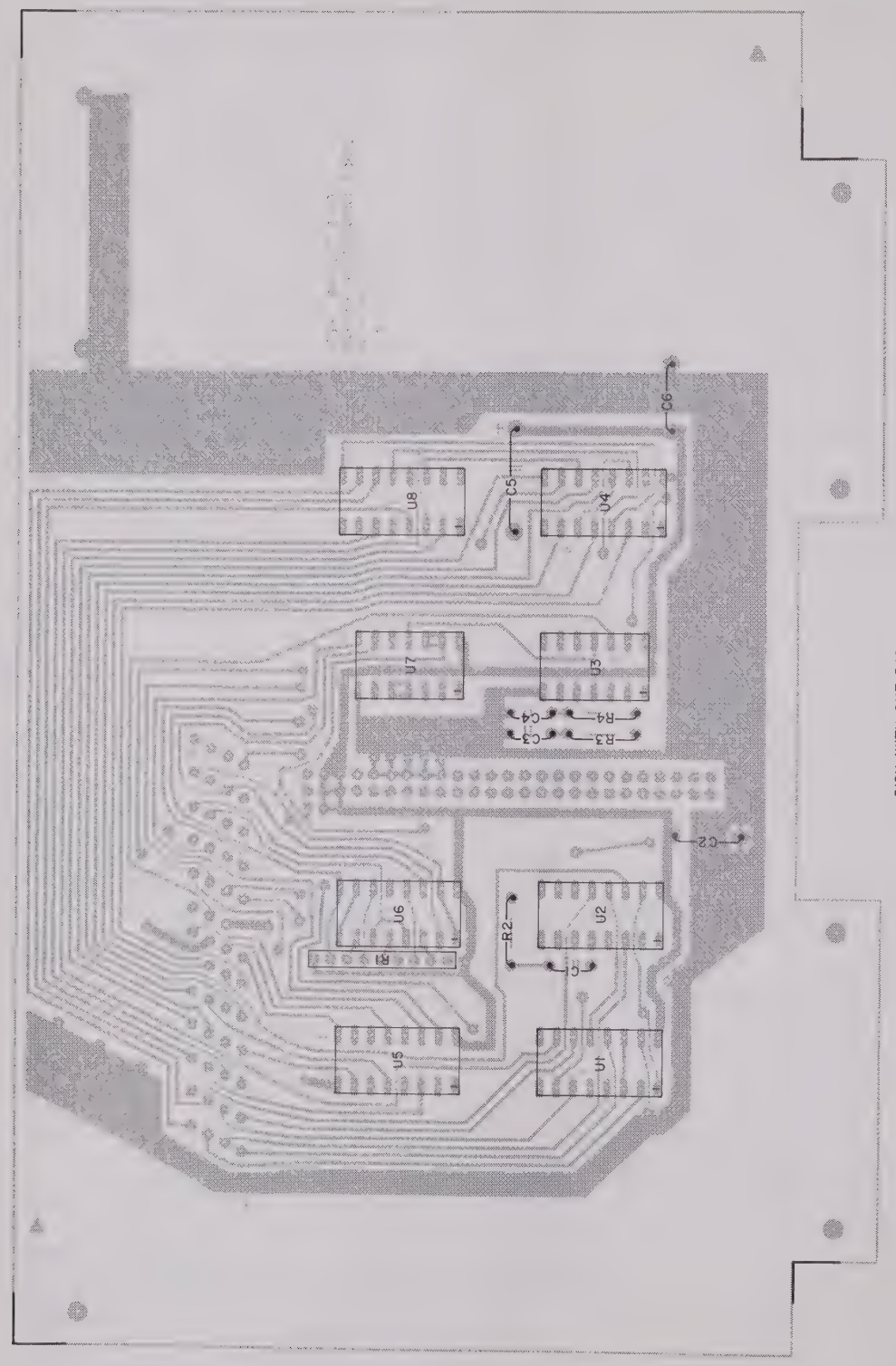

HP CABLE
WIRE COLOR CODE
2090 I/O
DI 0
1A NO
DI 1
2A DO 0
DI 2
3A DO 1
DI 3
4A DO 2
DI 4
5A DO 3
DI 5
6A DO 4
DI 6
7A DO 5
DI 7
8A DO 6
DI 8
9A DO 7
DI 9
10A DO 8
DI 10
11A DO 9
DI 11
12A DO 10
DI 12
13A DO 11
DI 13
DI 14
DI 15
DO 1
2B DI 0
DO 2
3B DI 1
DO 3
4B DI 2
DO 4
5B DI 3
DO 5
6B DI 4
DO 6
7B DI 5
DO 7
8B DI 6
DO 8
9B DI 7
DO 9
10B DI 8
DO 10
11B DI 9
DO 11
12B DI 10
DO 12
13B DI 11
PCTL
22B I/O STEP
PFLG
22A I/O FLAG
I/O
26B D R/W
25B N R/W
ST 10
24A LIVE
PRESET
CTLO
CTLI
27B I/O ACTIVE
19B RELSW
20B HOLD NEXT
23B ACI
74LS155
74121
500pf
PSTS
23A DISK ACTIVE
IN270
14B +5
15B +5
16B +5
JUMPERS 4,9,B,D,F ARE INSTALLED IN HP-98032A
DO 0
1B NI
14A
15A
16A
INNER BARE
2085N CALCULATOR INTERFACE FOR HEWLETT-PACKARD 9825A
NICOLET INSTRUMENT CORP
2085N CALCULATOR INTERFACE BOARD



DISK WITH OUT I/O
— CONDUCTOR SIDE —

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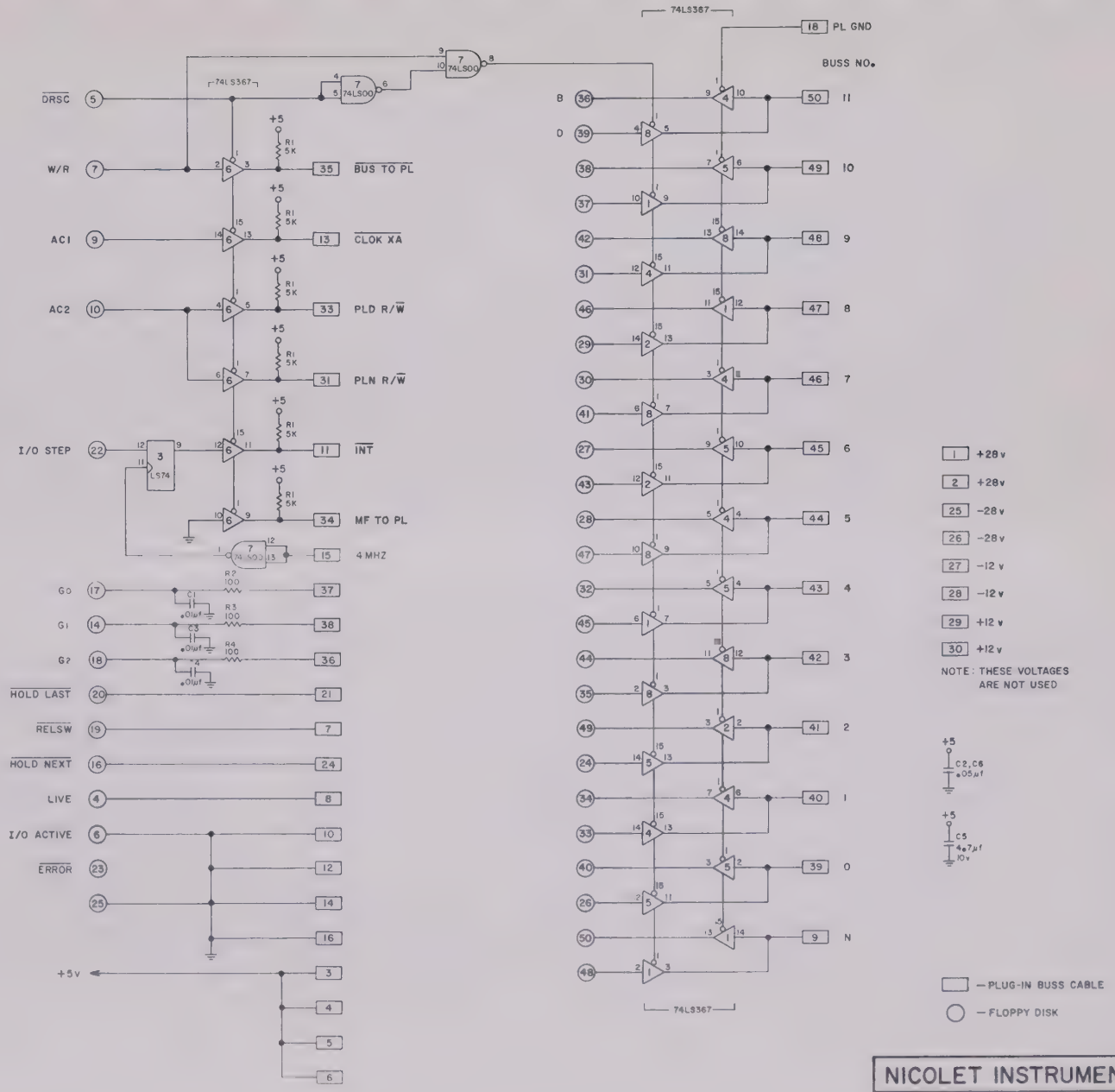
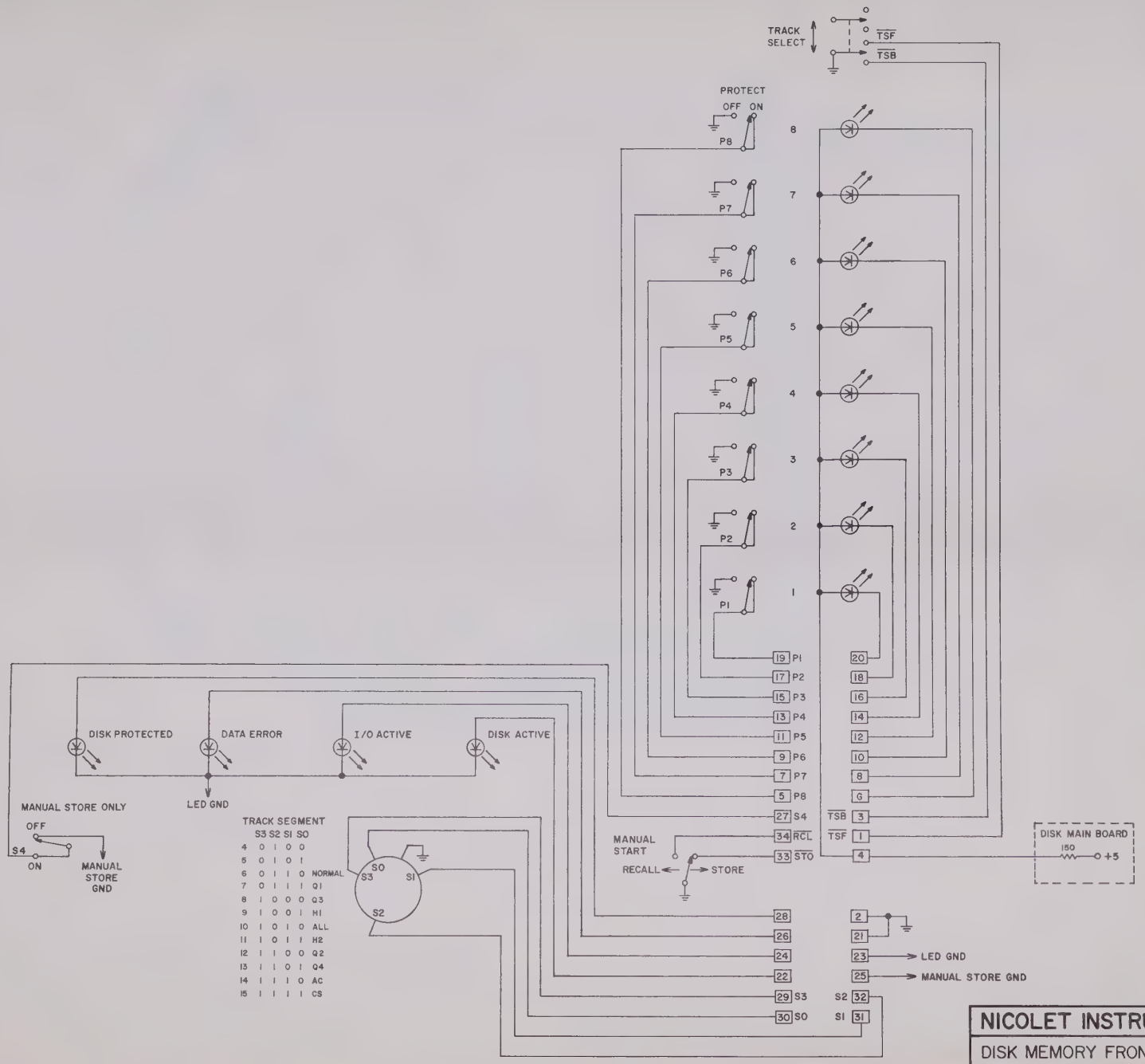


NICOLET INSTRUMENT CORP

DISK WITH OUT I/O

000-9027-02 LEK 12-5-79



NICOLET INSTRUMENT CORP

DISK MEMORY FRONT PANEL BOARD

000 [illegible] 9: [illegible] 78

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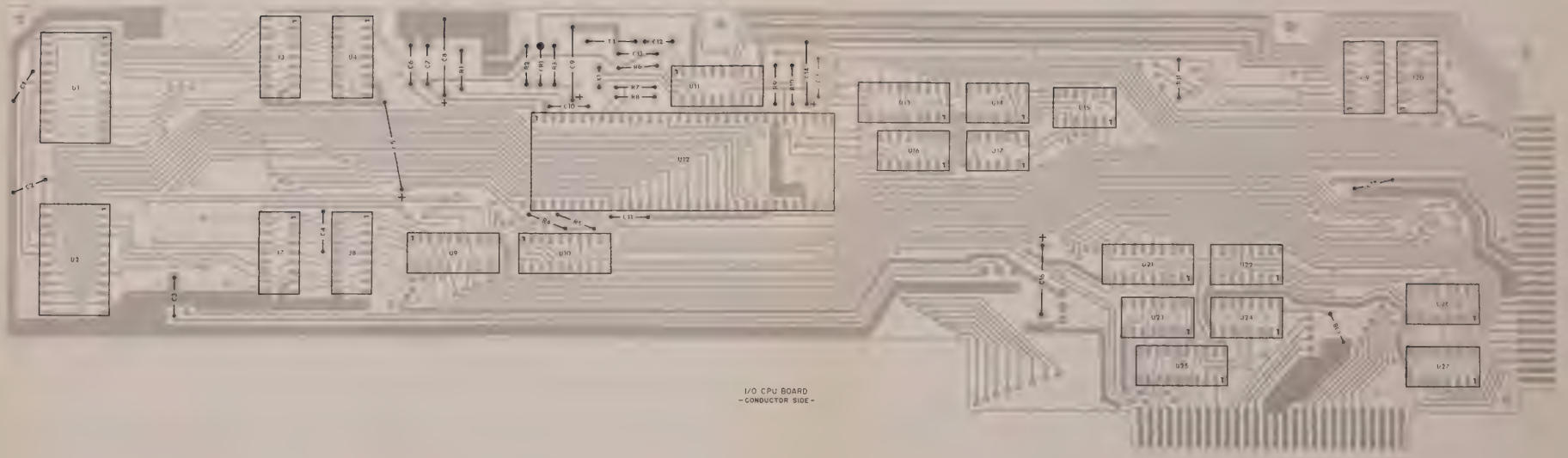

I/O CPU BOARD
- CONDUCTOR SIDE -

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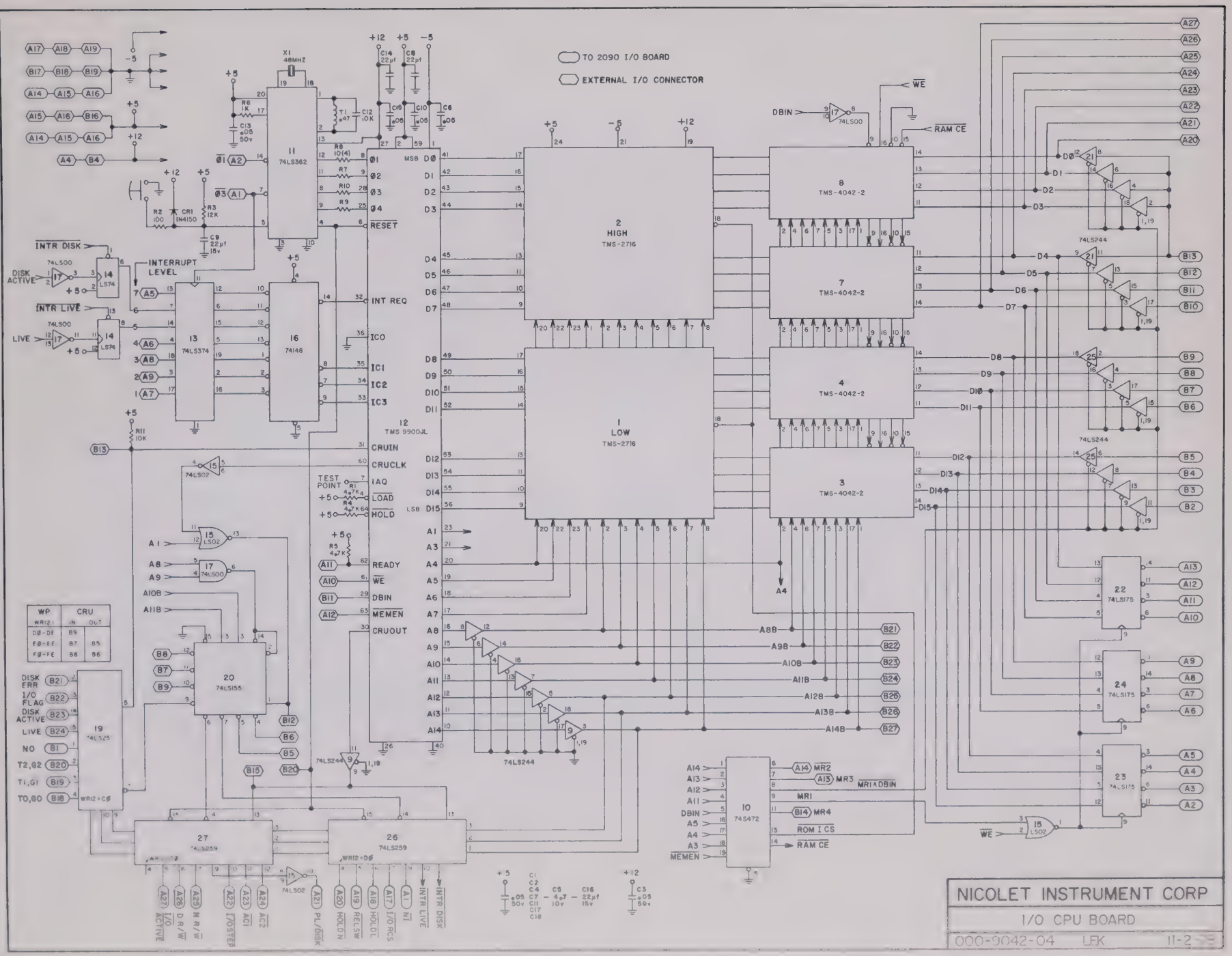
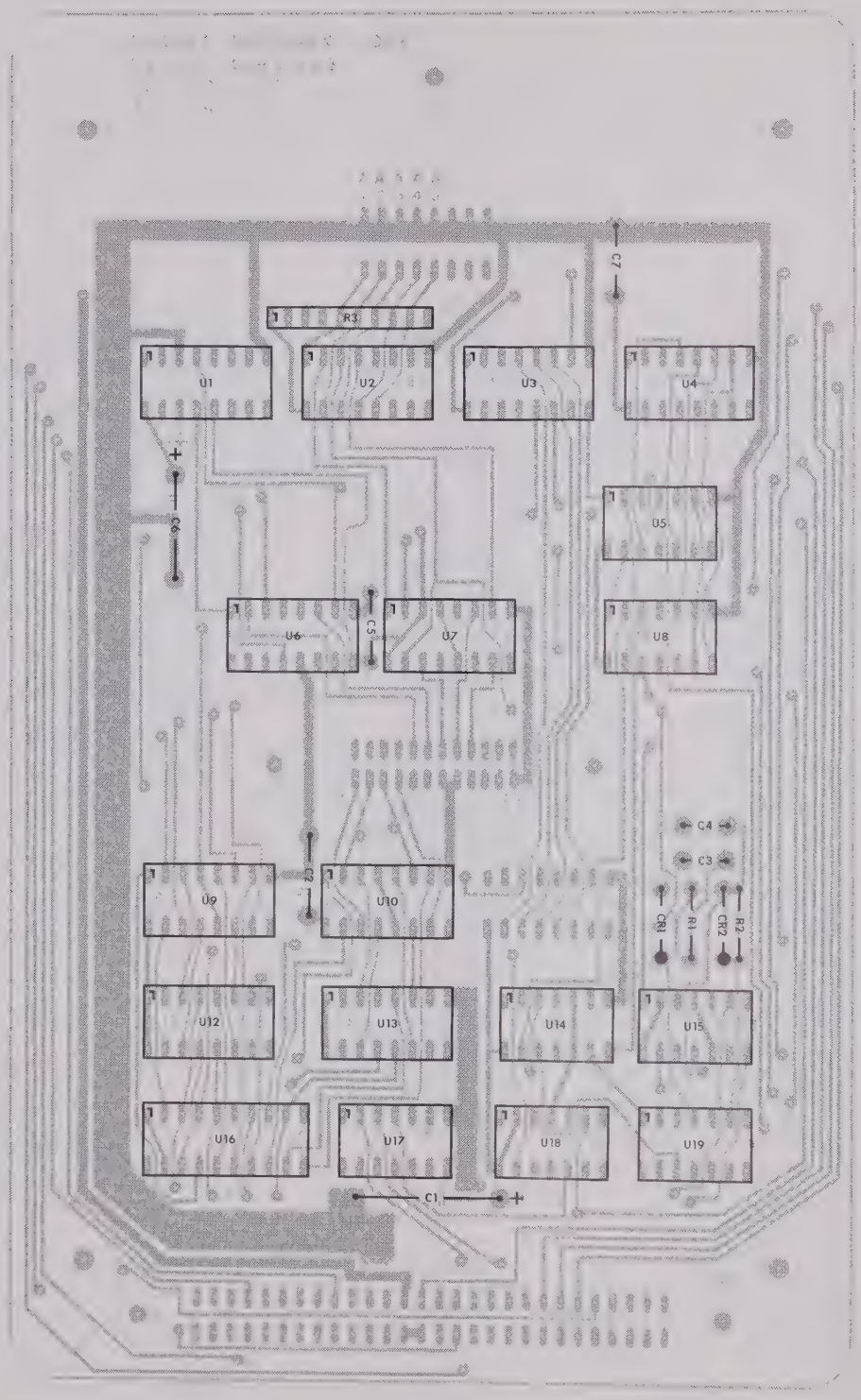

TO 2090 I/O BOARD
EXTERNAL I/O CONNECTOR
X1 48MHZ
11 74LS362
12 TMS 9900JL
2 HIGH TMS-2716
1 LOW TMS-2716
8 TMS-4042-2
7 TMS-4042-2
4 TMS-4042-2
3 TMS-4042-2
13 74LS374
16 74148
20 74LS155
19 74LS25
27 74LS259
26 74LS259
10 74S472
22 74LS175
24 74LS175
23 74LS175
74LS244
74LS502
74LS500
INTR DISK
INTR LIVE
INTERRUPT LEVEL
DISK ACTIVE
LIVE
INT REQ
ICO
IC1
IC2
IC3
CRUIN
CRUCLK
IAQ
LOAD
HOLD
READY
WE
DBIN
MEMEN
CRUOUT
RAM CE
ROM I CS
MR1
MR2
MR3
MR4
MR1ADBIN
NICOLET INSTRUMENT CORP
I/O CPU BOARD
000-9042-04 LFK 11-2



2081 GP-IB BOARD
– CONDUCTOR SIDE –

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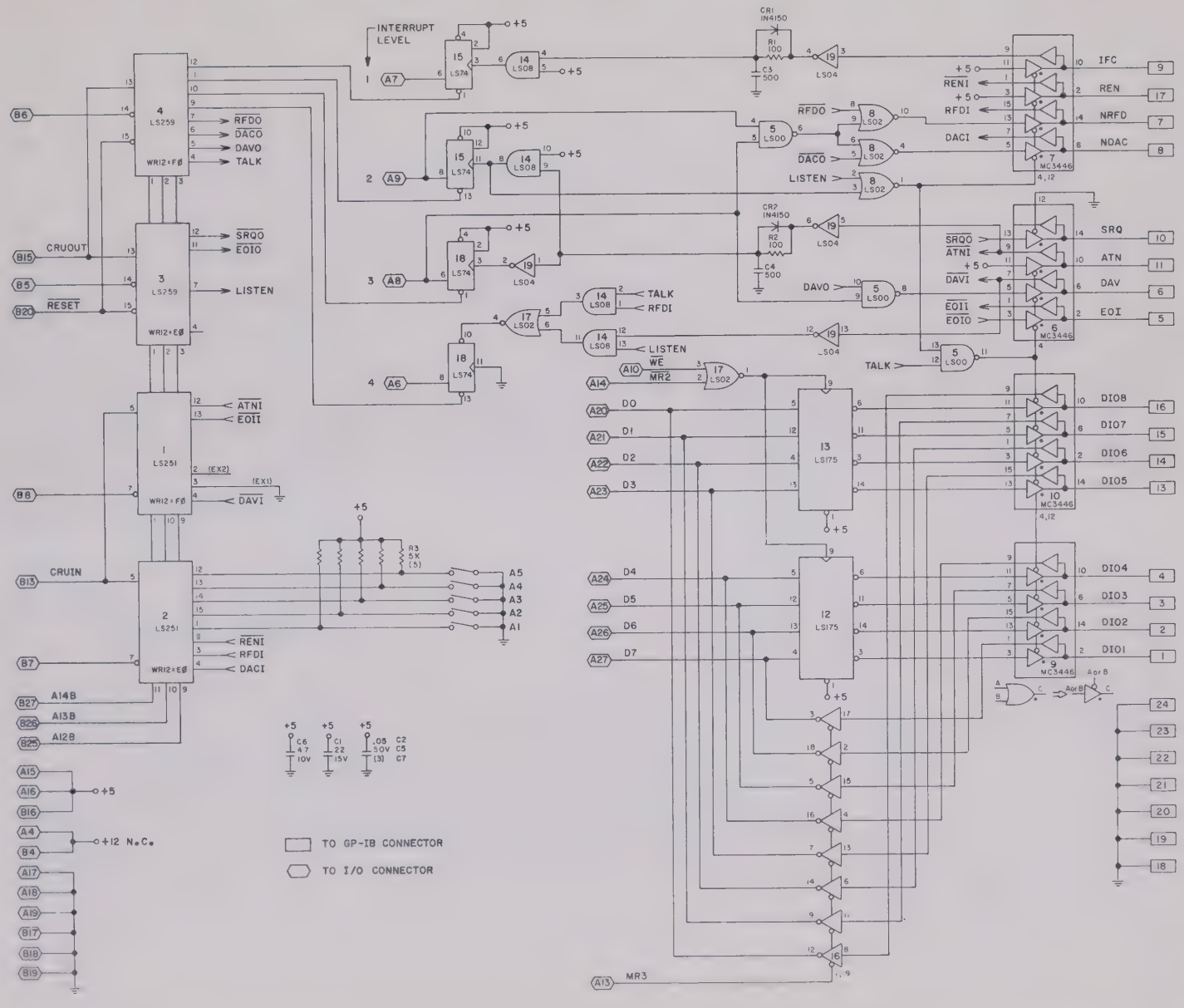
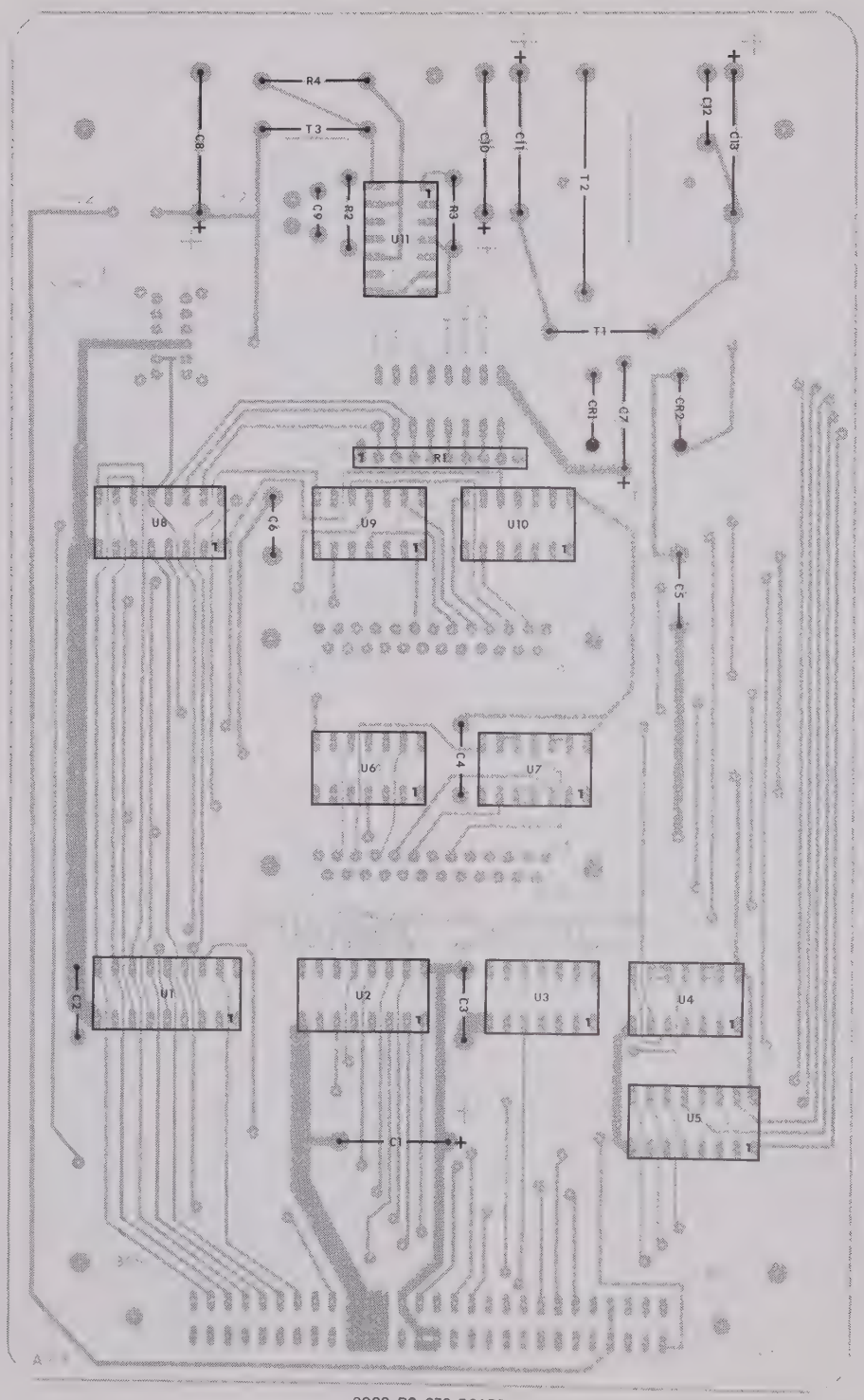


NICOLET INSTRUMENT CORP

2081 GP-IB BOARD



2082 RS-232 BOARD
— CONDUCTOR SIDE —

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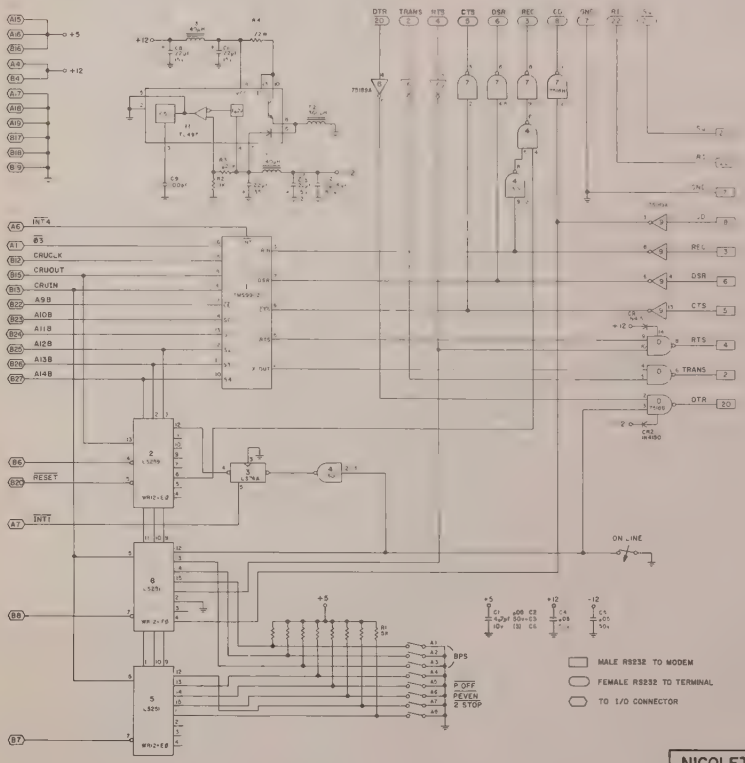

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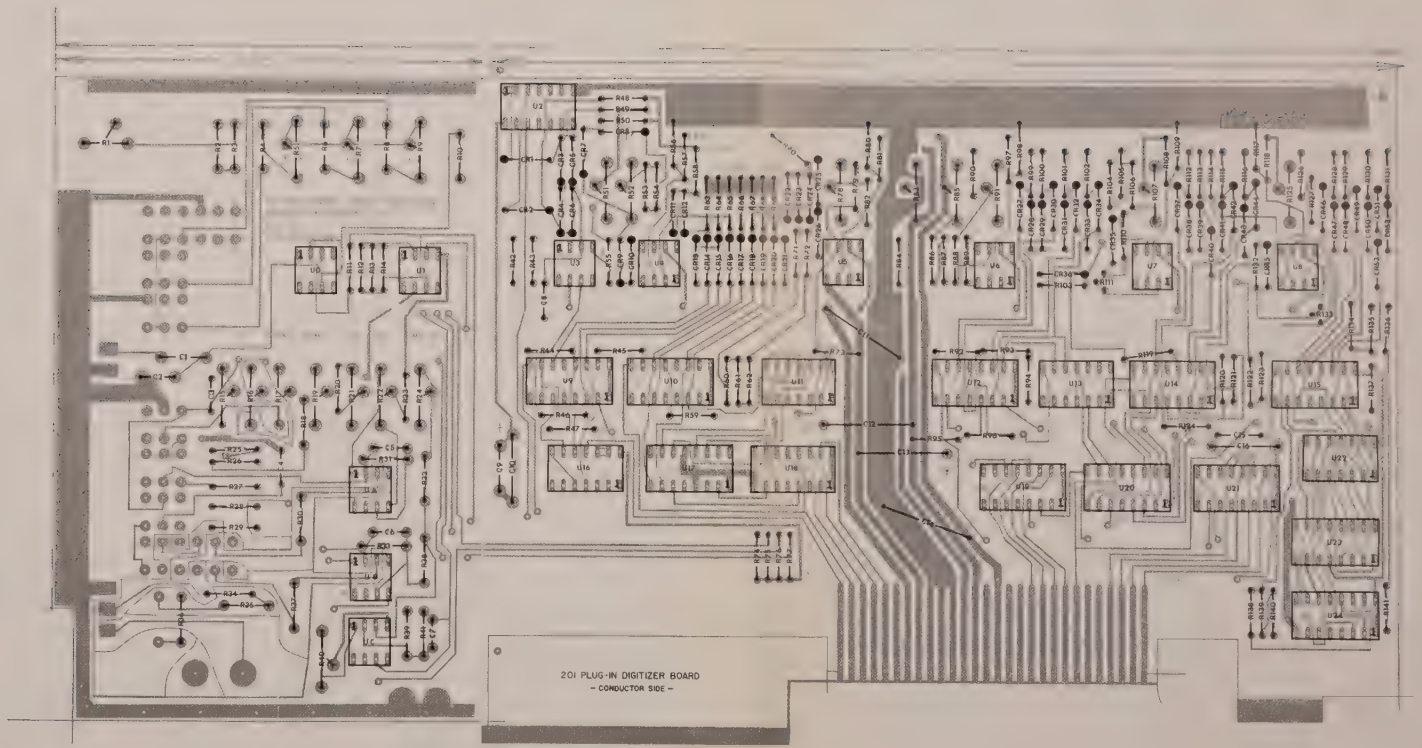
2082 RS-232 BOARD		
000-9045-02	LBK	12-5-79



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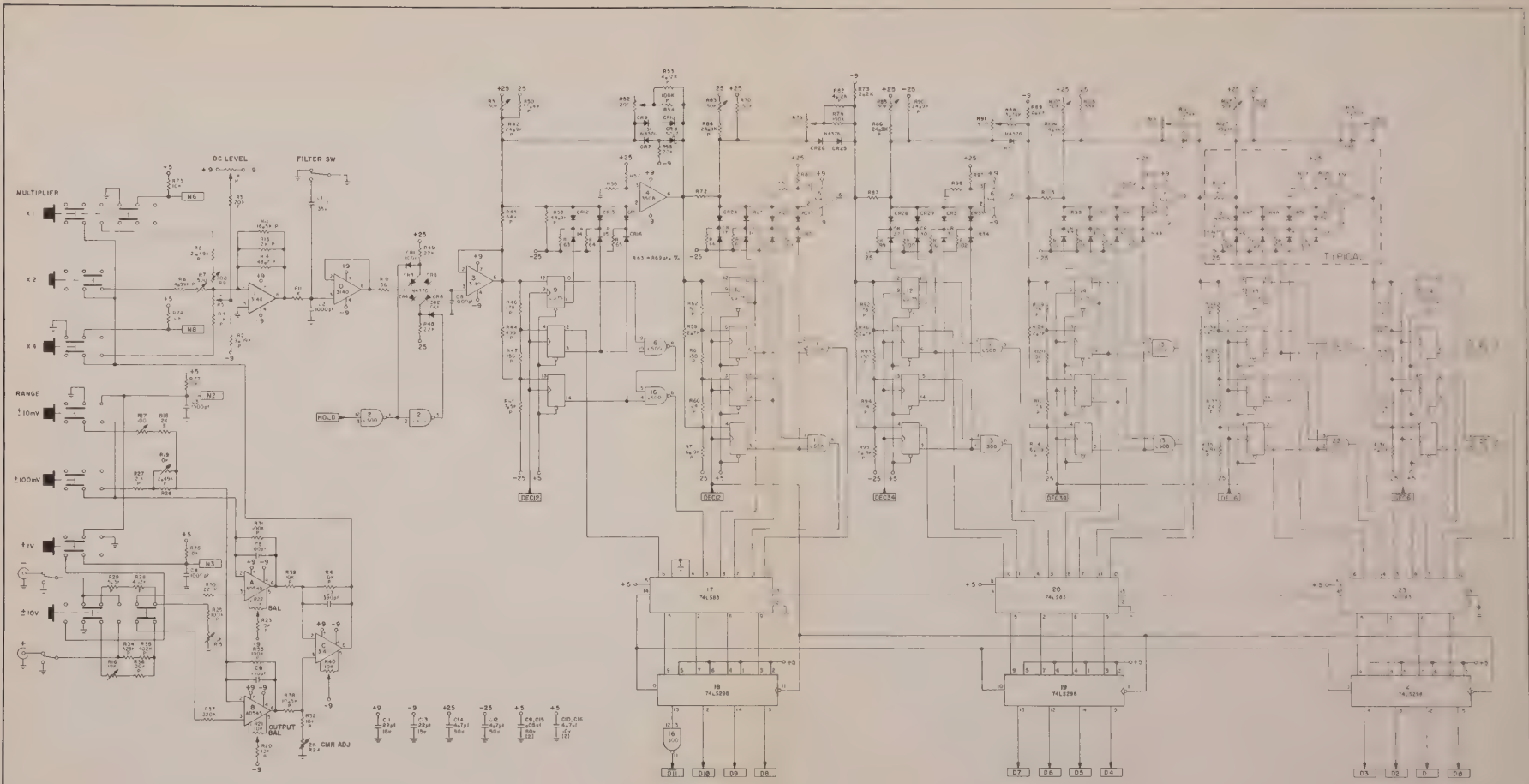
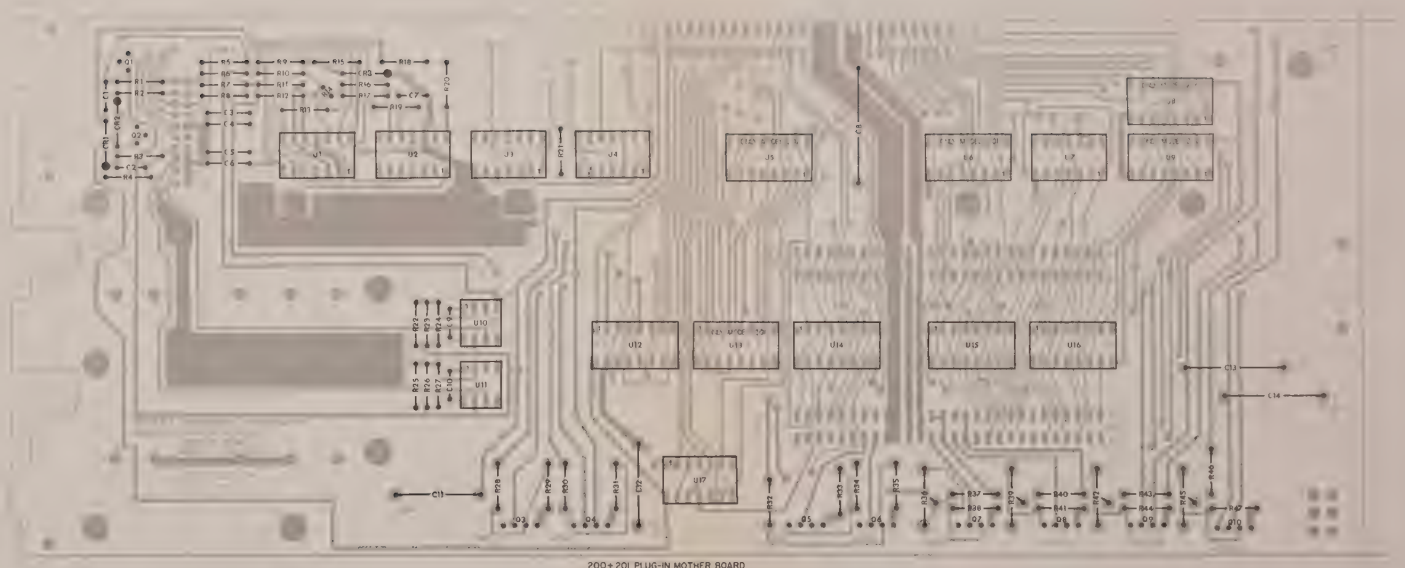


NICOLET INSTRUMENT CORP		
201 PLUG-IN DIGITIZER BOARD		
000-9040-06	LBK	12-10-79



200+201 PLUG-IN MOTHER BOARD
-CONDUCTOR SIDE-

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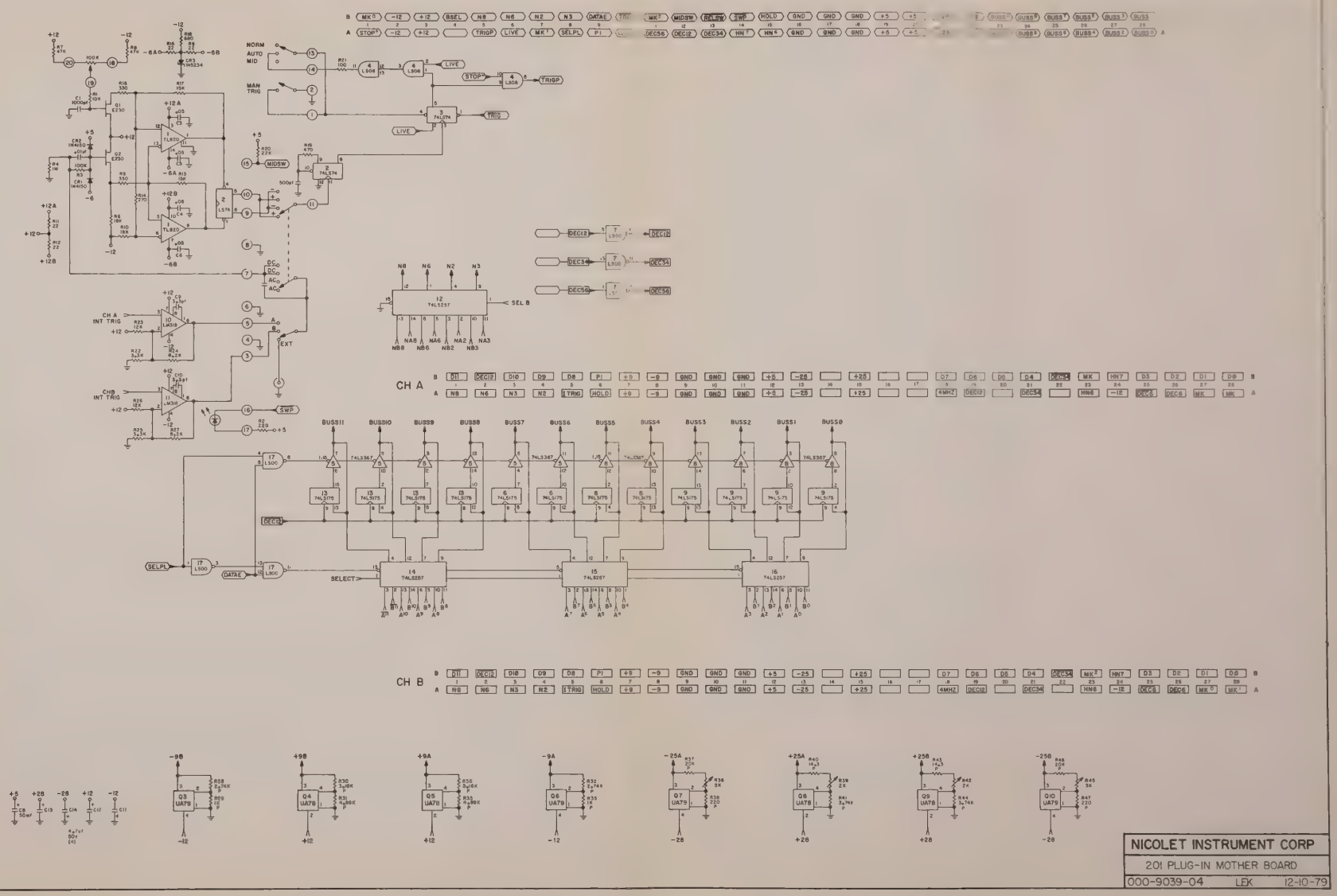
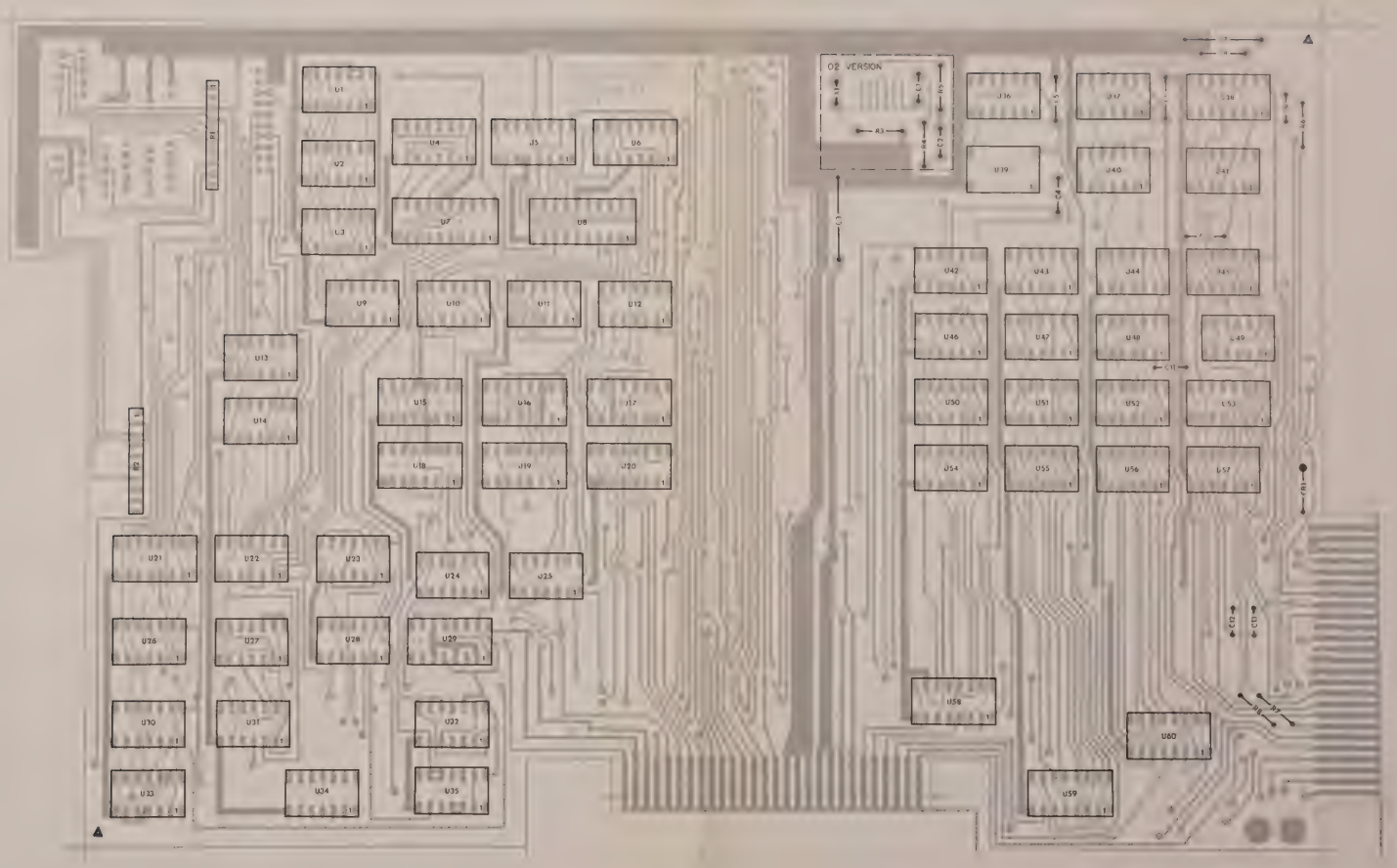

CH A
CH B
NORM
AUTO
MID
MAN
TRIG
CH A
INT TRIG
CH B
INT TRIG
EXT
SEL B
SELECT
NICOLET INSTRUMENT CORP
201 PLUG-IN MOTHER BOARD
000-9039-04
LEK
12-10-79



201 PLUG-IN CONTROL BOARD
-CONDUCTOR SIDE-

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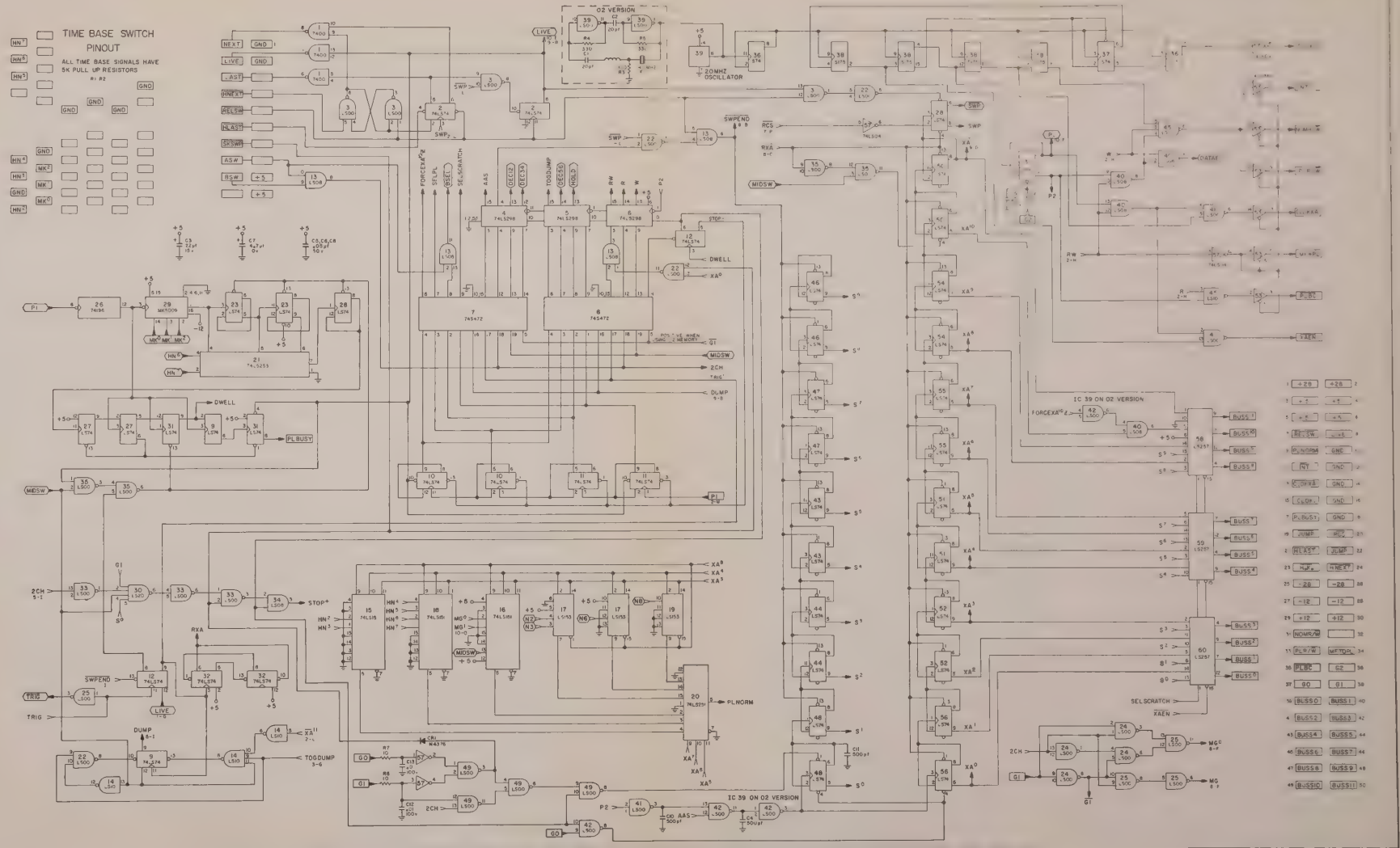
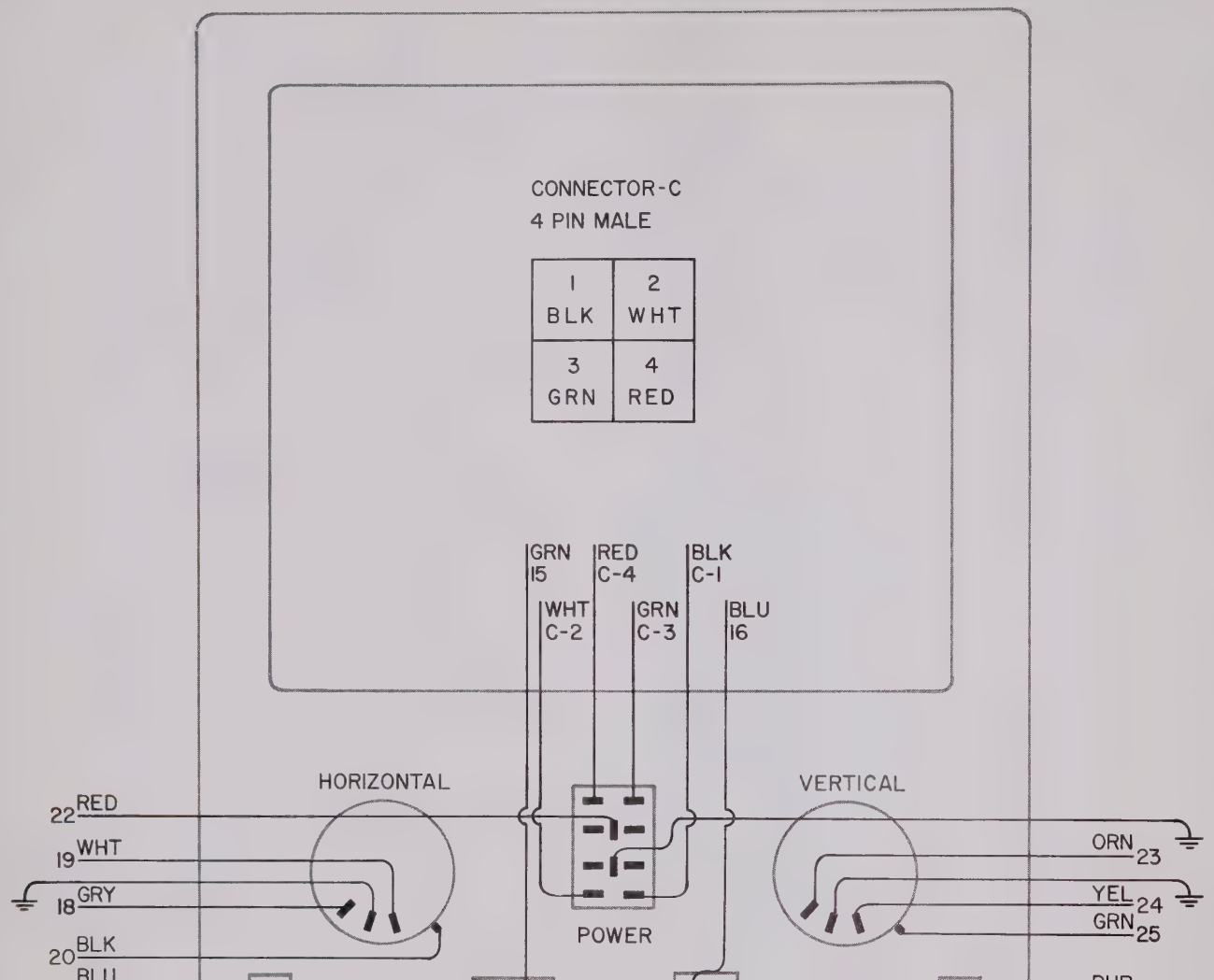
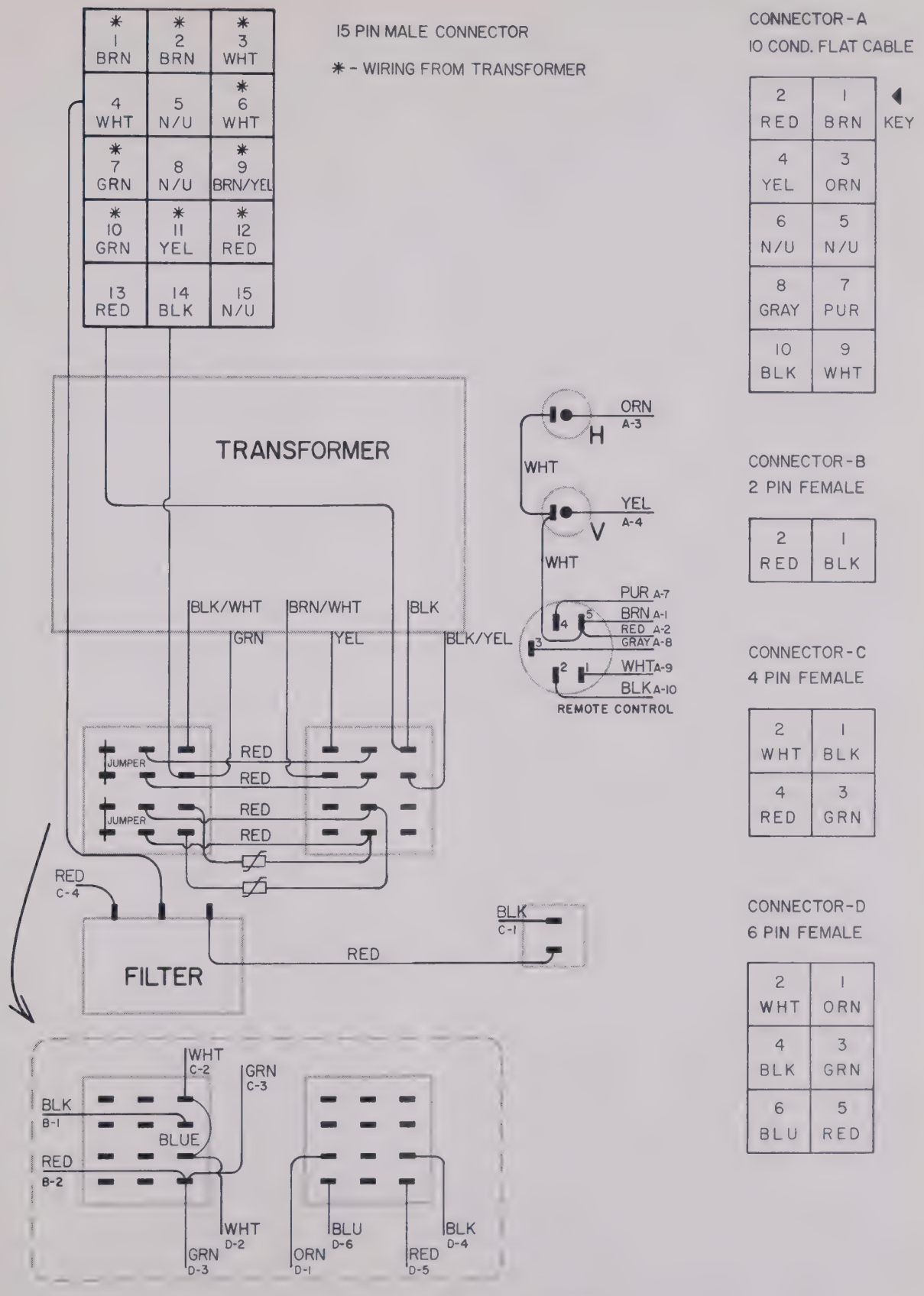

TIME BASE SWITCH PINOUT
ALL TIME BASE SIGNALS HAVE 5K PULL UP RESISTORS
02 VERSION
20MHZ OSCILLATOR
IC 39 ON 02 VERSION
NICOLET INSTRUMENT CORP
201 PLUG-IN CONTROL BOARD
000-9038-02,04 LEK 12-10-79


CONNECTOR-C
4 PIN MALE
1 BLK
2 WHT
3 GRN
4 RED
GRN 15
RED C-4
BLK C-1
WHT C-2
GRN C-3
BLU 16
HORIZONTAL
VERTICAL
POWER
22 RED
19 WHT
18 GRY
20 BLK
ORN 23
YEL 24
GRN 25



CONNECTOR-A
10 COND. FLAT CABLE

2 RED	1 BRN	◀ KEY
4 YEL	3 ORN	
6 N/U	5 N/U	
8 GRAY	7 PUR	
10 BLK	9 WHT	

CONNECTOR-B
2 PIN FEMALE

2 RED	1 BLK

CONNECTOR-C
4 PIN FEMALE

2 WHT	1 BLK
4 RED	3 GRN

CONNECTOR-D
6 PIN FEMALE

2 WHT	1 ORN
4 BLK	3 GRN
6 BLU	5 RED

REAR PANEL WIRING DIAGRAM

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002800			201-2 PLUG-IN				1
	1.....	415-006000	206 STORAGE CONTROL BD			EA	1.000
	2.....	000-900806	PCB/206 STORAGE CONTROL	X		EA	1.000
	2.....	025-726900	SW/PB/GREEN LED			EA	1.000
	2.....	025-733800	SW/PB 1P2TM SH SRUL/RED			EA	2.000
	2.....	035-701800	BUTT/RECT SH SRKL/BLK W/RED			EA	2.000
	2.....	085-708700	CBL/20 COND/AP 922531-20-99-3			EA	1.000
	2.....	108-022100	RES 220 05% 1/4W			EA	3.000
	2.....	108-022200	RES 2.2K 05% 1/4W			EA	3.000
	2.....	108-022300	RES 22K 05% 1/4W			EA	3.000
	1.....	415-009400	201-2 CONTROL BD			EA	1.000
	2.....	000-903802	PCB/CONTROL BD/201	X		EA	1.000
	2.....	022-711600	DIO TRRF 1N4376 10V .05A G FCH			EA	1.000
	2.....	023-029200	CAP 22MF 15V 10% TANT G KEM			EA	1.000
	2.....	023-700200	CAP 1000PF 300V 5% MICA R ARC			EA	1.000
	2.....	023-700300	CAP 500PF 500V 5% MICA R ARC			EA	2.000
	2.....	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	3.000
	2.....	023-709100	CAP 20PF 500V 5% MICA R ARC			EA	2.000
	2.....	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	1.000
	2.....	023-715100	CAP .05MF 50V CERM R ARC			EA	3.000
	2.....	024-715900	CON/16F DIP/SOL AMP 640358-3			EA	3.000
	2.....	024-734000	CONN/IC SOC/20 PIN			EA	2.000
	2.....	025-727000	SW/ROT/32 POS.			EA	1.000
	2.....	100-700700	RES NET/CSP10E-01-502J			EA	2.000
	2.....	108-010000	RES 10 05% 1/4W			EA	3.000
	2.....	108-033100	RES 330 05% 1/4W			EA	2.000
	2.....	108-047100	RES 470 05% 1/4W			EA	1.000
	2.....	134-701803	IC/7400N 2-NAND			EA	1.000
	2.....	134-711203	IC/74S74N FLIP-FLOP			EA	2.000
	2.....	134-712803	IC/74LS00N 2-NAND			EA	10.000
	2.....	134-712903	IC/74LS04N HEX INVERTER			EA	1.000
	2.....	134-713003	IC/74LS20N 4-NAND			EA	1.000
	2.....	134-713203	IC/74LS74N FLIP-FLOP			EA	21.000
	2.....	134-713703	IC/74LS253N MULTIPLEXER			EA	1.000
	2.....	134-713900	IC/MK5009P MOS LSI			EA	1.000
	2.....	134-715503	IC/74LS153N MULTIPLEXER			EA	2.000
	2.....	134-716203	IC/74S175N REGISTER			EA	1.000
	2.....	134-719103	IC/74196N COUNTER			EA	1.000
	2.....	134-719403	IC/74LS151N MULTIPLEXER			EA	3.000
	2.....	134-720803	IC/74LS10N 3-NAND			EA	2.000
	2.....	134-722303	IC/74LS298N REGISTER			EA	2.000
	2.....	134-722703	IC/74LS08N 2-AND			EA	3.000
	2.....	[illegible]	IC/74LS257 MULTIPLEXER			EA	2.000
	2.....	[illegible]	IC/74S472 PROM			EA	2.000
	2.....	[illegible]	IC/74LS[illegible]7N HEX DRIVER			EA	1.000
	2.....	[illegible]	IC/74LS[illegible]51N MULTIPLEXER			EA	[illegible]
	2.....	[illegible]	[illegible]			EA	[illegible]
	2.....	[illegible]	[illegible]			EA	[illegible]
	2.....	[illegible]	[illegible]			EA	[illegible]

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
005-002800			201-2 PLUG-IN				1
	2	021-706200	TRN FETJN E230 40V .35W B SLX			EA	2.000
	2	022-703800	DIO ZENR 1N5234 6.2V .5W G MOT			EA	1.000
	2	022-709400	DIO TRRF 1N4150 50V .2A G TXI			EA	2.000
	2	023-700200	CAP 1000PF 300V 5% MICA R ARC			EA	1.000
	2	023-700300	CAP 500PF 500V 5% MICA P ARC			EA	1.000
	2	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	1.000
	2	023-706900	CAP 50MF 50V ALUM G SPG			EA	1.000
	2	023-708000	CAP 3.3PF 1000V 15% CERM R CLB			EA	2.000
	2	023-713500	CAP 4.7MF 50V 10% TANT G KEM			EA	4.000
	2	023-715100	CAP .05MF 50V CERM R ARC			EA	4.000
	2	024-715900	CON/16P DIP/SOL AMP 640358-3			EA	6.000
	2	024-733200	CON/6M HDR/SOL AMP 9-350259-2			EA	1.000
	2	024-737200	CONN/56PIN/AMP 67907.3			EA	3.000
	2	026-705600	POT/2K PCB DAL 784-20-202			EA	2.000
	2	026-705700	POT/5K PCB DAL 784-20-502			EA	2.000
	2	108-010100	RES 100 05% 1/4W			EA	1.000
	2	108-010300	RES 10K 05% 1/4W			EA	1.000
	2	108-010400	RES 100K 05% 1/4W			EA	1.000
	2	108-010500	RES 1M 05% 1/4W			EA	1.000
	2	108-012300	RES 12K 05% 1/4W			EA	2.000
	2	108-015300	RES 15K 05% 1/4W			EA	2.000
	2	108-018300	RES 18K 05% 1/4W			EA	2.000
	2	108-022000	RES 22 05% 1/4W			EA	4.000
	2	108-022100	RES 220 05% 1/4W			EA	1.000
	2	108-022300	RES 22K 05% 1/4W			EA	1.000
	2	108-027100	RES 270 05% 1/4W			EA	1.000
	2	108-033100	RES 330 05% 1/4W			EA	2.000
	2	108-033200	RES 3.3K 05% 1/4W			EA	2.000
	2	108-047100	RES 470 05% 1/4W			EA	1.000
	2	108-047300	RES 47K 05% 1/4W			EA	2.000
	2	108-068100	RES 680 05% 1/4W			EA	1.000
	2	108-082200	RES 8.2K 05% 1/4W			EA	2.000
	2	121-702700	REG 5 TO 30V .5A 78MGU1C E FCH			EA	4.000
	2	121-702800	REG -2.2/-30V.5A 79MGU1C E FCH			EA	4.000
	2	134-711900	IC/LM318H OPAMP			EA	2.000
	2	134-712703	IC/TCL820CN3			EA	1.000
	2	134-712803	IC/74LS00N 2-NAND			EA	2.000
	2	134-713203	IC/74LS74N FLIP-FLOP			EA	2.000
	2	134-718803	IC/74LS175N REGISTER			EA	3.000
	2	134-722703	IC/74LS08N 2-AND			EA	1.000
	2	134-723903	IC/74LS257 MULTIPLEXER			EA	4.000
	2	134-730903	IC/74LS367N HEX DRIVER			EA	2.000
	2	201-100100	RES 1K 01% 1/8W PRES			EA	2.000
	2	201-143200	RES 14.3K 01% 1/8W PRES			EA	2.000
	2	201-200200	RES 20K 01% 1/8W PRES			EA	2.000
	2	201-221100	RES 2.21K 01% 1/8W PRES			EA	2.000
	2	201-274100	RES 2.74K 01% 1/8W PRES			EA	2.000
	2	201-316100	RES 3.16K 01% 1/8W PRES			EA	2.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002800			201-2 PLUG-IN				1
	1	201-374100	RES 3.74K 01% 1/8W PRES			EA	2.000
	1	201-499100	RES 4.99K 01% 1/8W PRES			EA	2.000
	1	415-009600	201-2 ADC BD			EA	2.000
	2	000-904004	PCB/201 ADC	X		EA	2.000
	2	022-703400	DIO ZENR 1N5227 3.6V .5W G MOT			EA	2.000
	2	022-711600	DIO TRRF 1N4376 10V .05A G FCH			EA	90.000
	2	022-714100	DIO SCHT HSCH1001 60V15MAG HPC			EA	8.000
	2	023-029200	CAP 22MF 15V 10% TANT G KEM			EA	4.000
	2	023-700100	CAP 100PF 500V 5% MICA R ARC			EA	4.000
	2	023-700200	CAP 1000PF 300V 5% MICA R ARC			EA	8.000
	2	023-704700	CAP 1MF 35V 10% TANT G KEM			EA	2.000
	2	023-706700	CAP 390PF 500V 5% MICA R ARC			EA	2.000
	2	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	4.000
	2	023-713500	CAP 4.7MF 50V 10% TANT G KEM			EA	4.000
	2	023-715100	CAP .05MF 50V CERM R ARC			EA	4.000
	2	023-718800	CAP 4.7PF 500V CERM G ERI			EA	2.000
	2	023-724800	CAP 3PF 500V CERM G ERI			EA	2.000
	2	024-715900	CON/16F DIP/SOL AMP 640358-3			EA	12.000
	2	024-743100	CONN/8F DIP/SOL AMP 640463-3	X		EA	20.000
	2	025-732000	SW/4STA/PB/2KG-C03100312			EA	2.000
	2	025-732100	SW/3STA/PB/2KGC021000311			EA	2.000
	2	026-705300	POT/200 PCB DAL 784-20-201			EA	6.000
	2	026-705400	POT/500 PCB DAL 784-20-501			EA	4.000
	2	026-705500	POT/1K PCB DAL 784-20-102			EA	2.000
	2	026-705600	POT/2K PCB DAL 784-20-202			EA	2.000
	2	026-705800	POT/10K PCB DAL 784-20-103			EA	10.000
	2	026-706200	POT/50K PCB DAL 784-20-503			EA	12.000
	2	026-706600	POT/100 PCB DAL 784-20-101			EA	2.000
	2	026-711100	POT/83CID-E20-J10/1K4			EA	2.000
	2	026-711400	POT/ET14P-500R MEPCO			EA	4.000
	2	035-701300	BUTT/PUSH CL J52305-04500			EA	14.000
	2	108-010200	RES 1K 05% 1/4W			EA	10.000
	2	108-010300	RES 10K 05% 1/4W			EA	8.000
	2	108-010400	RES 100K 05% 1/4W			EA	2.000
	2	108-010500	RES 150K 05% 1/4W			EA	2.000
	2	108-022200	RES 2.2K 05% 1/4W			EA	4.000
	2	108-022300	RES 22K 05% 1/4W			EA	6.000
	2	108-022400	RES 220K 05% 1/4W			EA	4.000
	2	108-027200	RES 2.7K 05% 1/4W			EA	8.000
	2	108-033300	RES 33K 05% 1/4W			EA	4.000
	2	108-056000	RES 56 05% 1/4W			EA	2.000
	1	134-[illegible]	IC/74LS83N ADDER			EA	1.000
	2	134-712803	IC/74LS00N 2-NAND			EA	4.000
	2	134-718803	IC/74LS175N REGISTER			EA	14.000
	2	134-[illegible]	IC/74LS298N REGISTER			EA	6.000
	2	134-722703	IC/74LS08N [illegible]			EA	6.000
	2	134-[illegible]	[illegible]			EA	[illegible]
	2	[illegible]	[illegible]			EA	[illegible]

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
865-00200			201-2 PLUG-IN				1
	2	134-743500	IC/AD 545L OP AMP ANALOG DEV.			EA	4.000
	2	201-100100	RES 1K 01% 1/8W PRES			EA	18.000
	2	201-100200	RES 10K 01% 1/8W PRES			EA	12.000
	2	201-100300	RES 100K 01% 1/8W PRES			EA	10.000
	2	201-105200	RES 10.5K 01% 1/8W PRES			EA	2.000
	2	201-124000	RES 124 01% 1/8W PRES			EA	10.000
	2	201-150000	RES 150 01% 1/8W PRES			EA	14.000
	2	201-165200	RES 16.5K 01% 1/8W PRES			EA	2.000
	2	201-178000	RES 178 01% 1/8W PRES			EA	10.000
	2	201-200100	RES 2K 01% 1/8W PRES			EA	4.000
	2	201-200200	RES 20K 01% 1/8W PRES			EA	2.000
	2	201-210200	RES 21K 01% 1/8W PRES			EA	7.000
	2	201-249100	RES 2.49K 01% 1/8W PRES			EA	4.000
	2	201-249200	RES 24.9K 01% 1/8W PRES			EA	20.000
	2	201-332100	RES 3.32K 01% 1/8W PRES			EA	2.000
	2	201-374100	RES 3.74K 01% 1/8W PRES			EA	4.000
	2	201-374200	RES 37.4K 01% 1/8W PRES			EA	2.000
	2	201-402300	RES 402K 01% 1/8W PRES			EA	4.000
	2	201-412100	RES 4.12K 01% 1/8W PRES			EA	6.000
	2	201-487200	RES 48.7K 01% 1/8W PRES			EA	2.000
	2	201-499000	RES 499 01% 1/8W PRES			EA	2.000
	2	201-499100	RES 4.99K 01% 1/8W PRES			EA	2.000
	2	201-499200	RES 49.9K 01% 1/8W PRES			EA	28.000
	2	201-523300	RES 523K 01% 1/8W PRES			EA	4.000
	2	201-619100	RES 6.19K 01% 1/8W PRES			EA	10.000
	2	201-649000	RES 649 01% 1/8W PRES			EA	2.000
	2	201-750000	RES 750 01% 1/8W PRES			EA	2.000
	2	201-750100	RES 7.5K 01% 1/8W PRES			EA	2.000
	2	201-909100	RES 9.09K 01% 1/8W PRES			EA	2.000
	2	214-499200	RES 49.9K .1% 1/8W PRES			EA	14.000
	1	465-002100	201-2 FRONT PANEL			EA	1.000
	2	010-700900	NUT/BL ANODI W-NU-17D			EA	1.000
	2	011-721607	BRKT/MOTHER BD/EXPL	X		EA	1.000
	2	022-714500	DIO LEDG 406G 1.9V 10MA M 1NM			EA	1.000
	2	024-058900	CON/1F CXL/SOL APH F-UG 657-U			EA	5.000
	2	025-718000	SW/C + K #8531			EA	1.000
	2	025-727600	SW/CTS/#T202/2 POLE/2-5STA			EA	3.000
	2	025-727900	SW/GF-126-PC-G20-18			EA	9.000
	2	026-710000	POT/100K/C.L. BA147-0134			EA	1.000
	2	045-703200	KNOB/KPN-500BA/1/8			EA	3.000
	2	045-703500	KNOB/KPN-900BA-1/4"			EA	1.000
	2	045-703600	KNOB/KN-500BA-1/8"			EA	3.000
	2	068-736903	PAN/201-2 FRONT	X		EA	1.000
	2	068-741200	PAN/201-2 FRONT SUB	X		EA	1.000
	2	085-900100	CBL/20 COND/PLUG-IN FRONT	X		EA	1.000
	2	093-702400	FASTNR/SCR 6-32 X 1/4" BLK			EA	4.000
	1	475-003300	201-2 MECH ASSY			EA	1.000
	2	020-701808	CHAS/PLUG-IN			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002800			201-2 PLUG-IN				1
	2.....	034-713300	GUIDE/SCANBE #11633-4			EA	2.000
	2.....	042-711001	COVER/206 AMP DIVIDER	X		EA	1.000
	2.....	085-705400	PROBE/COLINE 900-90-505			EA	2.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002500			204-1 PLUG IN				1
	1.....	415-007800	204 ADC BD			EA	1.000
	2.....	000-903001	PCB/204 ADC			EA	1.000
	2.....	021-702200	TRANSIS/2N3903			EA	6.000
	2.....	021-703200	TRANSIS/2N5047			EA	4.000
	2.....	021-704700	TRANSIS/2N5224/NPN/12V/.6MW			EA	8.000
	2.....	021-710200	TRANS/2N5179			EA	8.000
	2.....	021-710300	TRANS/A400			EA	7.000
	2.....	021-710400	TRANS/SD-203DC			EA	5.000
	2.....	021-710700	TRANS/A-406			EA	2.000
	2.....	021-710800	TRANS/A-440			EA	1.000
	2.....	022-708000	DIODE/1N5236/ZENER/7.5V			EA	2.000
	2.....	022-711500	DIODE/REGULATOR 78GUIC			EA	2.000
	2.....	022-711600	DIODE/1N4376/.75 NS TRR/20V			EA	11.000
	2.....	022-713000	DIODE/FDH-300			EA	1.000
	2.....	022-714100	DIODE/HSCH 1001/SCHOTTKY			EA	31.000
	2.....	022-715500	DIODE/HSCH 1004			EA	1.000
	2.....	023-029200	CAP/22MF 10% 15V TANT AXL.			EA	2.000
	2.....	023-700100	CAP/100PF 5% 500V MICA RAD			EA	2.000
	2.....	023-700500	CAP/250PF 5% 500V MICA RAD			EA	1.000
	2.....	023-702400	CAP/.01MF 20% 100V CERM RAD			EA	6.000
	2.....	023-708000	CAP/3.3PF 15% 1000V CERM RAD			EA	1.000
	2.....	023-708800	CAP/33PF 5% 500V MICA RAD			EA	1.000
	2.....	023-710200	CAP/5.5-18PF 50V CERM RAD			EA	2.000
	2.....	023-710600	CAP/10PF 10% 1000V CERM RAD			EA	2.000
	2.....	023-710800	CAP/.1MF 10% 200V PLYE AXL			EA	2.000
	2.....	023-711200	CAP/220MF 10% 10V TANT AXL			EA	3.000
	2.....	023-713400	CAP/1MFD 50V			EA	2.000
	2.....	023-715500	CAP/1.5PFD-.25PFD			EA	5.000
	2.....	023-716500	CAP/2.0 PF ERIE 500VDC			EA	1.000
	2.....	023-717900	CAP/8PFD 300V			EA	2.000
	2.....	023-718800	CAP/4.7PFD			EA	4.000
	2.....	023-722600	CAP/.1MFD @ 250V 5%			EA	15.000
	2.....	024-715900	CON/16F DIP/SOL AMP 640358-3			EA	13.000
	2.....	024-739300	CONN/MOLEX 22-12-2101			EA	1.000
	2.....	025-731000	SW/1055P/REL-18-3			EA	1.000
	2.....	026-705500	POT/1K PCB DAL 784-20-102			EA	1.000
	2.....	026-711100	POT/831D-E20-J10/1K4			EA	1.000
	2.....	026-711300	POT/ET14P-100R MEPCO			EA	5.000
	2.....	026-711400	POT/ET14P-500R MEPCO			EA	3.000
	2.....	026-711500	POT/ET14P-1K MEPCO			EA	4.000
	2.....	026-711600	POT/ET14P-2K MEPCO			EA	1.000
	2.....	026-711700	POT/ET14P-5K MEPCO			EA	1.000
	2.....	026-711800	POT/ET14P-50K MEPCO			EA	1.000
	2.....	026-711900	POT/ET14P-1MEG MEPCO			EA	2.000
	2.....	100-701900	RES NET/CSP10E-01-500J			EA	7.000
	2.....	108-010100	RES/100OHM/1/4W/5%			EA	3.000
	2.....	108-010200	RES/1K/1/4W/5%			EA	6.000
	2.....	108-010300	RES/10K/1/4W/5%			EA	2.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002500			204-1 PLUG IN				1
	2	108-012100	RES/1200HM/1/4W/5%			EA	3.000
	2	108-012200	RES/1.2K/1/4W/5%			EA	1.000
	2	108-015100	RES/1500HM/1/4W/5%			EA	2.000
	2	108-015500	RES/1.5M/1/4W/5%			EA	1.000
	2	108-018100	RES/1800HM/1/4W/5%			EA	1.000
	2	108-018200	RES/1.8K/1/4W/5%			EA	1.000
	2	108-022100	RES/2200HM/1/4W/5%			EA	1.000
	2	108-022200	RES/2.2K/1/4W/5%			EA	2.000
	2	108-022500	RES/2.2MEG/1/4W/5%			EA	1.000
	2	108-027100	RES/2700HM/1/4W/5%			EA	6.000
	2	108-027200	RES/2.7K/1/4W/5%			EA	1.000
	2	108-033000	RES/330HM/1/4W/5%			EA	7.000
	2	108-033200	RES/3.3K/1/4W/5%			EA	1.000
	2	108-039000	RES/390HM/1/4W/5%			EA	1.000
	2	108-039200	RES/3.9K/1/4W/5%			EA	2.000
	2	108-047000	RES/470HM/1/4W/5%			EA	6.000
	2	108-047100	RES/4700HM/1/4W/5%			EA	3.000
	2	108-047200	RES/4.7K/1/4W/5%			EA	3.000
	2	108-056100	RES/5600HM/1/4W/5%			EA	1.000
	2	108-068000	RES/680HM/1/4W/5%			EA	4.000
	2	108-068100	RES/6800HM/1/4W/5%			EA	5.000
	2	108-082000	RES/820HM/1/4W/5%			EA	1.000
	2	108-082100	RES/820 OHM 1/4W 5%			EA	1.000
	2	134-737900	IC/F100150FC ECL FLIP-FLOP			EA	4.000
	2	134-738000	IC/F95L23DC			EA	6.000
	2	134-738100	IC/F95102DC			EA	1.000
	2	134-738200	IC/F10176DC ECL FLIP-FLOP			EA	2.000
	2	134-738300	IC/F95107DC			EA	2.000
	2	134-738400	IC/F10125FC ECL TRANSLATOR			EA	2.000
	2	201-100100	PRES/ 1/8W 1K			EA	1.000
	2	201-100400	PRES 1/8W/1. MEG 1/8W			EA	1.000
	2	201-105100	PRES 1/8W/1.05K I.R.C.			EA	4.000
	2	201-124200	PRES 1/8W/12.4K			EA	1.000
	2	201-130100	PRES 1/8W/1.3K MF5C T-0			EA	1.000
	2	201-143200	PRES 1/8W/14.3K			EA	2.000
	2	201-162400	RES/P 1.62M			EA	2.000
	2	201-169200	PRES 1/8W/16.9K I.R.C.			EA	11.000
	2	201-178000	RES/1/8W./178 OHM			EA	3.000
	2	201-178100	PRES 1/8W/1.78K I.R.C.			EA	1.000
	2	201-178300	PRES 1/8W/178K			EA	1.000
	2	201-200100	PRES 1/8W/2K IRC			EA	1.000
	2	201-249200	PRES 1/8W/24.9K			EA	1.000
	2	[illegible]	PRES 1/8W/3.32K I.R.C.			EA	1.000
	2	[illegible]365000	PRES/ 1/8W 365 OHM 1%			EA	1.000
	2	[illegible]374100	PRES 1/8W/3.74K			EA	3.000
	2	[illegible]412100	PRES 1/8W/4.12K			EA	1.000
	2	[illegible]	[illegible]			EA	[illegible]
	2	[illegible]	[illegible]			EA	[illegible]

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002500			204-1 PLUG IN				1
	2.....	201-576100	PRES/ 1/8W /5.76K 1%			EA	1.000
	2.....	201-681000	PRES 1/8W/I.R.C. 6.81K			EA	4.000
	2.....	201-681900	PRES 1/8W/68.1 OHMS CEA-			EA	4.000
	2.....	201-715000	PRES/ 1/8W /715 OHM			EA	2.000
	2.....	201-750000	RES/1/8W/1%/750OHM			EA	2.000
	2.....	201-806100	PRES/ 1/8W 8.06K 1%			EA	1.000
	2.....	201-825000	PRES 1/8W/825 OHM I.R.C.			EA	5.000
	2.....	201-825100	PRES 1/8W/8.25K			EA	3.000
	1.....	415-008000	STORAGE CNTRL BRD/204			EA	1.000
	2.....	000-903201	P.C.B./STOR CONT/204	X		EA	1.000
	2.....	024-739800	CONN/MOLEX 22-10-2031			EA	3.000
	2.....	025-721600	SW/PB 1P2TM SH SRL/BLK/RED			EA	2.000
	2.....	025-726900	SW/PB/GREEN LED			EA	1.000
	2.....	108-015300	RES/15K/1/4W/5%			EA	3.000
	2.....	108-022100	RES/2200HM/1/4W/5%			EA	3.000
	1.....	415-008100	204 MEMORY BD			EA	1.000
	2.....	000-902902	P.C.B./MEM BD/204	X		EA	1.000
	2.....	015-706300	PIN/350663-6 AMP SPOOL			EA	3.000
	2.....	021-708800	TRANSIS/2N5301			EA	1.000
	2.....	022-700800	DIODE/1N4004/1 AMP/400V			EA	1.000
	2.....	022-707100	DIODE/3 SM2			EA	2.000
	2.....	022-714000	DIODE/REG/LAS723			EA	1.000
	2.....	023-700200	CAP/1000PF 5% 300V MICA RAD			EA	1.000
	2.....	023-701600	CAP/2.2MF 10% 20V TANT AXL			EA	1.000
	2.....	023-702400	CAP/.01MF 20% 100V CERM RAD			EA	18.000
	2.....	023-711100	CAP/4.7MF 10% 10V TANT AXL			EA	4.000
	2.....	023-711200	CAP/220MF 10% 10V TANT AXL.			EA	1.000
	2.....	023-715100	CAP/.05MF 50V CERM RAD			EA	9.000
	2.....	024-727000	CON/6M REC/CRP AMP 1-350234-9			EA	1.000
	2.....	024-739900	CONN/MOLEX 22-16-2051			EA	1.000
	2.....	032-700800	INSUL/DIODE			EA	1.000
	2.....	034-715500	GUIDE/SCANBE 11633-1			EA	4.000
	2.....	085-708600	CBL/34 COND/AP 922541-34-99-3			EA	2.000
	2.....	098-700400	HT SNK/P.C.B. COOLER			EA	1.000
	2.....	103-010100	RES 1W/100 OHM			EA	1.000
	2.....	108-015200	RES/1.5K/1/4W/5%			EA	1.000
	2.....	108-022300	RES/22K/1/4W/5%			EA	2.000
	2.....	108-033000	RES/330HM/1/4W/5%			EA	1.000
	2.....	134-711203	IC/74S74N FLIP-FLOP			EA	1.000
	2.....	134-723903	IC/74LS257 MULTIPLEXER			EA	4.000
	2.....	134-724900	IC/74S169 COUNTER			EA	3.000
	2.....	134-737400	IC/P2115AL			EA	32.000
	2.....	134-739003	IC/74S374N REGISTER			EA	2.000
	2.....	134-739103	IC/74LS244N OCTAL BUFFER			EA	6.000
	2.....	134-739203	IC/74S32N 2-OR			EA	2.000
	2.....	134-739303	IC/74S139N DEMULTIPLEXER			EA	1.000
	2.....	134-739403	IC/74S157N MULTIPLEXER			EA	2.000
	2.....	201-124100	PRES 1/8W/1.24K MF5C			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002500			204-1 PLUG IN				1
	2.....	201-221100	PRES 1/8W/2.21K			EA	1.000
	2.....	201-316100	PRES 1/8W/3.16K IRC			EA	1.000
	2.....	201-825000	PRES 1/8W/825 OHM I.R.C.			EA	1.000
	1.....	415-008200	204 CONTROL BD			EA	1.000
	2.....	000-903303	PCB/204 CONTROL	X		EA	1.000
	2.....	019-704500	CHOKE/COIL			EA	2.000
	2.....	019-708800	XFORMER/INDUCT/AGUIRE			EA	1.000
	2.....	021-702200	TRANSIS/2N3903			EA	1.000
	2.....	021-703800	TRANSIS/2N5978			EA	1.000
	2.....	021-705100	TRANSIS/2N2905A			EA	1.000
	2.....	022-709400	DIODE/1N4150			EA	1.000
	2.....	022-713000	DIODE/FDH-300			EA	2.000
	2.....	022-715800	DIODE/REGULATOR/TI SG3524J			EA	1.000
	2.....	022-715900	DIODE/VARO VSK 540			EA	1.000
	2.....	023-029200	CAP/22MF 10% 15V TANT AXL			EA	1.000
	2.....	023-702400	CAP/.01MF 20% 100V CERM RAD			EA	5.000
	2.....	023-706800	CAP/150PF 5% 500V MICA RAD			EA	1.000
	2.....	023-711000	CAP/22MF 10% 35V TANT AXL			EA	2.000
	2.....	023-711100	CAP/4.7MF 10% 10V TANT AXL			EA	5.000
	2.....	023-711200	CAP/220MF 10% 10V TANT AXL			EA	2.000
	2.....	023-715100	CAP/.05MF 50V CERM RAD			EA	26.000
	2.....	023-716400	CAP/12PFD 300V			EA	1.000
	2.....	023-717000	CAP/3PFD 300V			EA	1.000
	2.....	023-717500	CAP/28KMF 15V ALUM SCW			EA	1.000
	2.....	023-718200	CAP/27PF 5% 300V MICA RAD			EA	1.000
	2.....	023-719600	CAP/18PFD 300V			EA	2.000
	2.....	023-722600	CAP/.1MFD @ 250V 5%			EA	1.000
	2.....	024-714400	CON/20F REC/IDP MMM 3421-0000			EA	2.000
	[illegible]	024-715500	CONN/3399-6000			EA	2.000
	[illegible]	024-715900	CON/16F DIP/SOL AMP 640358-3			EA	6.000
	[illegible]	024-739900	CONN/MOLEX 22-16-2051			EA	1.000
	[illegible]	024-740000	CONN/MOLEX 22-16-2101			EA	2.000
	[illegible]	024-[illegible]	SW/POT/32 POS.			EA	1.000
	[illegible]	024-715500	GUIDE/SCANBE 11633-1			EA	4.000
	[illegible]	024-700900	CLIP/FICHCO V-1011			EA	1.000
	[illegible]	098-705300	HT SNK/6072B			EA	1.000
	[illegible]	100-700700	RES NET/CSP10E-01-502J			EA	3.000
	1.....	100-701900	RES NET/CSP10E-01-500J			EA	3.000
	2.....	101-010900	RES/1/2W/5 10%/1 OHM			EA	1.000
	2.....	105-082100	RES/820HM/2W/5%			EA	1.000
	2.....	108-010000	RES/10 OHM/1/4W/5%			EA	1.000
	2.....	108-010300	RES/10K/1/4W/5%			EA	4.000
	2.....	108-010500	RES/1MEG/1/4W/5%			EA	1.000
	2.....	108-012300	RES/12K/1/4W/5%			EA	5.000
	[illegible]	[illegible]	[illegible]			EA	2.000
	2.....	108-022100	RES/2200HM/1/4W/5%			EA	1.000
	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
BNS-002500			204-1 PLUG IN				1
	2	108-027300	RES/27K/1/4W/5%			EA	1.000
	2	108-033000	RES/330HM/1/4W/5%			EA	1.000
	2	108-047100	RES/4700HM/1/4W/5%			EA	3.000
	2	108-082200	RES/8.2K/1/4W/5%			EA	3.000
	2	134-711203	IC/74S74N FLIP-FLOP			EA	5.000
	2	134-712803	IC/74LS00N 2-NAND			EA	3.000
	2	134-713203	IC/74LS74N FLIP-FLOP			EA	2.000
	2	134-713703	IC/74LS253N MULTIPLEXER			EA	2.000
	2	134-713900	IC/MK5009P MOS LSI			EA	1.000
	2	134-715503	IC/74LS153N MULTIPLEXER			EA	2.000
	2	134-716003	IC/74S86 2-XOR			EA	1.000
	2	134-716803	IC/74123N MONOSTABLE			EA	1.000
	2	134-718303	IC/74S02N 2-NOR			EA	1.000
	2	134-718803	IC/74LS175N REGISTER			EA	1.000
	2	134-719403	IC/74LS151N MULTIPLEXER			EA	4.000
	2	134-719503	IC/74S288N PROM			EA	1.000
	2	134-720503	IC/74LS174N REGISTER			EA	2.000
	2	134-720803	IC/74LS10N 3-NAND			EA	1.000
	2	134-722703	IC/74LS08N 2-AND			EA	1.000
	2	134-723903	IC/74LS257 MULTIPLEXER			EA	3.000
	2	134-724900	IC/74S169 COUNTER			EA	2.000
	2	134-730903	IC/74LS367N HEX DRIVER			EA	1.000
	2	134-731603	IC/74LS251N MULTIPLEXER			EA	1.000
	2	134-736003	IC/74S283J ADDER			EA	1.000
	2	134-738000	IC/F95L23DC			EA	2.000
	2	134-738100	IC/F95102DC			EA	2.000
	2	134-738200	IC/F10176DC ECL FLIP-FLOP			EA	1.000
	2	134-738400	IC/F10125PC ECL TRANSLATOR			EA	1.000
	2	134-738500	IC/F10010DC ECL DECADE COUNTER			EA	2.000
	2	134-738600	IC/F10106DC			EA	2.000
	2	134-738700	IC/F10115DC ECL RECEIVER			EA	1.000
	2	134-738800	IC/F10131DC ECL FLIP-FLOP			EA	5.000
	2	134-738900	IC/F10124PC ECL TRANSLATOR			EA	1.000
	2	134-739203	IC/74S32N 2-OR			EA	1.000
	2	134-739403	IC/74S157N MULTIPLEXER			EA	1.000
	2	191-705600	CRYS/100 MHZ .0025%			EA	1.000
	2	201-127100	PRES 1/8W/1.27K			EA	1.000
	2	201-237100	PRES 1/8W/2.37K I.R.C.			EA	3.000
	2	201-750100	PRES 1/8W/7.5K			EA	1.000
	1	415-008900	204-1 FRONT PANEL BD			EA	1.000
	2	000-903103	PCB/204 FRONT PANEL	X		EA	1.000
	2	021-703200	TRANSIS/2N5047			EA	1.000
	2	021-704700	TRANSIS/2N5224/NPN/12V/.6MW			EA	1.000
	2	021-708600	TRANSIS/SD211			EA	3.000
	2	021-710200	TRANS/2N5179			EA	3.000
	2	022-703700	DIODE/1N5231/ZENER/5.1V			EA	1.000
	2	022-709400	DIODE/1N4150			EA	1.000
	2	022-711600	DIODE/1N4376/.75 NS TRR/20V			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002500			204-1 PLUG IN				1
	2	023-700100	CAP/100PF 5% 500V MICA RAD			EA	3.000
	2	023-700400	CAP/47PF 5% 500V MICA RAD			EA	2.000
	2	023-702400	CAP/.01MF 20% 100V CERM RAD			EA	1.000
	2	023-710600	CAP/10PF 10% 1000V CERM RAD			EA	1.000
	2	023-722600	CAP/.1MFD @ 250V 5%			EA	5.000
	2	024-739400	CONN/MOLEX 22-17-2102			EA	1.000
	2	024-739500	CONN/MOLEX 22-10-2051			EA	3.000
	2	024-739600	CONN/MOLEX 22-10-2101			EA	1.000
	2	024-739700	CONN/MOLEX 09-48-3032			EA	3.000
	2	024-740800	CONN/2 PIN/6010-22-18-2023			EA	1.000
	2	025-730500	SW/CL2K811AC1S45XXX			EA	1.000
	2	025-730600	SW/CL2K813AC1S45XXXX			EA	7.000
	2	025-730700	SW/CL 2KK9BBB2-XXXXX			EA	2.000
	2	025-730800	SW/CL 2KK9CCBZ-XXXXX			EA	2.000
	2	026-711200	POT/3862C-366-353A/25K			EA	1.000
	2	035-701300	BUTT/PUSH CL J52305-04500			EA	24.000
	2	100-700700	RES NET/CSP10E-01-502J			EA	1.000
	2	134-701803	IC/7400N 2-NAND			EA	1.000
	2	134-712803	IC/74LS00N 2-NAND			EA	1.000
	2	134-713203	IC/74LS74N FLIP-FLOP			EA	2.000
	2	134-723903	IC/74LS257 MULTIPLEXER			EA	1.000
	1	475-002400	204-1 MECH ASSY			EA	1.000
	2	022-714500	DIODE/LED 406 GREEN			EA	1.000
	2	024-058900	CON/1F CXL/SOL APH F-UG 657-U			EA	3.000
	2	044-705400	SHIELD/204 PLUG-IN	X		EA	1.000
	2	044-706500	SHIELD/204 SWITCH	X		EA	1.000
	2	045-703500	KNOB/KPN-900BA-1/4"			EA	2.000
	2	045-703600	KNOB/KN-500BA-1/8"			EA	2.000
	2	045-704100	KNOB/KNS-501BA ALCO			EA	1.000
	2	068-733401	FAN/FRONT/204-1	X		EA	1.000
	2	085-705400	PROBE/COLINE 900-90-505			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-003500			204A PLUG-IN				1
	1	415-010500	204A STORAGE CONTROL BD			EA	1.000
	2	000-906801	PCB/204A STORAGE CONTROL	X		EA	1.000
	2	025-726900	SW/PB/GREEN LED			EA	1.000
	2	025-733800	SW/PB 1P2TM SH SRUL/RED			EA	2.000
	2	025-734600	SW/TO 1PL2T AL TT11DG-PC-4			EA	4.000
	2	035-701800	BUTT/RECT SH SRNL/BLK W/RED			EA	2.000
	2	108-015300	RES 15K 05% 1/4W			EA	3.000
	2	108-022100	RES 220 05% 1/4W			EA	3.000
	2	108-022300	RES 22K 05% 1/4W			EA	4.000
	1	415-010600	204A TRIGGER BD			EA	1.000
	2	000-906901	PCB/204A TRIGGER	X		EA	1.000
	2	021-701800	TRN PNP 2N3905 40V .35W B MOT			EA	1.000
	2	021-703200	TRN FETJN 2N5047 50V .2W A MOT			EA	1.000
	2	022-713000	DIO RECT FDH300 150V .2A G FCH			EA	1.000
	2	023-700100	CAP 100PF 500V 5% MICA R ARC			EA	2.000
	2	023-700400	CAP 47PF 500V 5% MICA R ARC			EA	2.000
	2	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	1.000
	2	023-707500	CAP 6.8MF 35V 10% TANT G KEM			EA	2.000
	2	023-708800	CAP 33PF 500V 5% MICA P ARC			EA	1.000
	2	023-709100	CAP 20PF 500V 5% MICA R ARC			EA	1.000
	2	023-711300	CAP .1MF 250V 10% PLYE R SEC			EA	10.000
	2	023-718800	CAP 4.7PF 500V CERM G ERI			EA	1.000
	2	025-734700	SW/PB 18L2T CL			EA	1.000
	2	026-713400	POT/5K PCB 2W 81C1DE20A BRS			EA	1.000
	2	108-010200	RES 1K 05% 1/4W			EA	1.000
	2	108-010300	RES 10K 05% 1/4W			EA	5.000
	2	108-010400	RES 100K 05% 1/4W			EA	1.000
	2	108-022100	RES 220 05% 1/4W			EA	1.000
	2	108-022300	RES 22K 05% 1/4W			EA	2.000
	2	108-033100	RES 330 05% 1/4W			EA	1.000
	2	108-033200	RES 3.3K 05% 1/4W			EA	1.000
	2	108-033400	RES 330K 05% 1/4W			EA	2.000
	2	108-047000	RES 47 05% 1/4W			EA	2.000
	2	108-068000	RES 68 05% 1/4W			EA	1.000
	2	108-068400	RES 680K 05% 1/4W			EA	1.000
	2	121-702600	REG 2T038V .15A LAS1000 A LAM			EA	1.000
	2	134-712803	IC/74LS00N 2-NAND			EA	1.000
	2	134-713203	IC/74LS74N FLIP-FLOP			EA	2.000
	2	134-715303	IC/7438N O/C 2-NAND			EA	2.000
	2	134-727600	IC/1458 OPAMP			EA	1.000
	2	134-749100	IC/NE527 VOLTAGE COMPARATOR			EA	1.000
	2	201-100100	RES 1K 01% 1/8W PRES			EA	1.000
	2	201-100200	RES 10K 01% 1/8W PRES			EA	2.000
	2	201-130100	RES 1.3K 01% 1/8W PRES			EA	1.000
	2	201-200100	RES 2K 01% 1/8W PRES			EA	1.000
	2	201-499100	RES 4.99K 01% 1/8W PRES			EA	3.000
	2	201-909100	RES 9.09K 01% 1/8W PRES			EA	2.000
	1	415-010700	204A ADC BD			EA	2.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-003500			204A PLUG-IN				1
	2.....	000-906301	PCB/204A ADC	X		EA	2.000
	2.....	021-701800	TRN PNP 2N3905 40V .35W B MOT			EA	6.000
	2.....	021-702200	TRN NPN 2N3903 40V 1W B MOT			EA	10.000
	2.....	021-703200	TRN FETJN 2N5047 50V .2W A MOT			EA	2.000
	2.....	022-700800	DIO RECT 1N4004 400V 1A G TXI			EA	4.000
	2.....	022-711600	DIO TRRF 1N4376 10V .05A G FCH			EA	2.000
	2.....	022-713000	DIO RECT FDH300 150V .2A G FCH			EA	2.000
	2.....	022-714100	DIO SCHT HSCH1001 60V15MAG HPC			EA	2.000
	2.....	023-700100	CAP 100PF 500V 5% MICA R ARC			EA	4.000
	2.....	023-700200	CAP 1000PF 300V 5% MICA R ARC			EA	2.000
	2.....	023-700500	CAP 250PF 500V 5% MICA R ARC			EA	2.000
	2.....	023-707500	CAP 6.8MF 35V 10% TANT G KEM			EA	8.000
	2.....	023-708800	CAP 33PF 500V 5% MICA R ARC			EA	2.000
	2.....	023-710200	CAP 5.5 TO 18PF 50V CERM STT			EA	4.000
	2.....	023-710600	CAP 10PF 1000V 10% CERM R CLB			EA	2.000
	2.....	023-711200	CAP 220MF 10V 10% TANT G KEM			EA	2.000
	2.....	023-711300	CAP .1MF 250V 10% PLYE R SEC			EA	32.000
	2.....	023-715300	CAP 3.3PF 500V 25% CERM G ERI			EA	2.000
	2.....	023-715500	CAP 1.5 TO .25PF TRIMMER R EFJ			EA	6.000
	2.....	023-716400	CAP 12PF 300V 5% MICA R ARC			EA	4.000
	2.....	023-716900	CAP 1.5 PFD ERIE			EA	2.000
	2.....	023-717900	CAP 8PF 300V 6.2% MICA R ARC			EA	4.000
	2.....	023-725900	CAP 3.5 TO 10PF 63V CERM STT			EA	4.000
	2.....	024-745000	CON/64F DIP/SOL BDY DILBQ64P			EA	2.000
	2.....	025-734500	SW/SL 1P2T CK 1101M2AV2B			EA	2.000
	2.....	025-734800	SW/SL 2P2T CK 1101M2AB			EA	2.000
	2.....	025-735100	SW/RO 6PL9PS SG 1378P/REL-18-3			EA	2.000
	2.....	026-707500	NOT ON FILE			EA	2.000
	2.....	026-708000	POT/2K PCB 3299W-1-202			EA	2.000
	2.....	026-710700	POT/200 PCB BRS 3299W-1-201			EA	2.000
	2.....	026-712000	POT 1K PCB .5W 3299W1101 BRS			EA	2.000
	2.....	026-712500	POT/5K PCB BRS 3299W-1-502			EA	2.000
	2.....	026-713200	POT 500 PCB .5W 3299W1501 BRS			EA	6.000
	2.....	026-713300	POT 2M PCB .5W 3299W1205 BRS	X		EA	4.000
	2.....	026-713500	POT/5K PCB 1W 83C1DE28J BRS	X		EA	2.000
	2.....	098-700200	HT SNK/207CB W			EA	2.000
	2.....	101-010100	RES 100 05% 1/2W			EA	2.000
	2.....	101-010900	RES 1 10% 1/2W			EA	6.000
	2.....	101-082000	RES 82 05% 1/2W			EA	2.000
	2.....	108-010000	RES 10 05% 1/4W			EA	6.000
	2.....	108-010100	RES 100 05% 1/4W			EA	8.000
	2.....	108-010200	RES 1K 05% 1/4W			EA	4.000
	2.....	108-022100	RES 220 05% 1/4W			EA	4.000
	2.....	108-022300	RES 22K 05% 1/4W			EA	[illegible]
	2.....	108-047200	[illegible] 05% 1/4W			EA	[illegible]
	2.....	108-056100	[illegible]			EA	[illegible]
	2.....	121-702600	[illegible]			EA	[illegible]
	2.....	134-730600	IC/CA3140S OPAMP			EA	[illegible]

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-003500			204A PLUG-IN				1
	2	134-739003	IC/74S374N REGISTER			EA	2.000
	2	134-748900	IC/TDS 5130 8 BIT 50NS ADC			EA	2.000
	2	134-749000	IC/CA3054 OP AM			EA	2.000
	2	201-100100	RES 1K 01% 1/8W PRES			EA	6.000
	2	201-100200	RES 10K 01% 1/8W PRES			EA	2.000
	2	201-100400	RES 1M 01% 1/8W PRES			EA	2.000
	2	201-130100	RES 1.3K 01% 1/8W PRES			EA	4.000
	2	201-143200	RES 14.3K 01% 1/8W PRES			EA	2.000
	2	201-162400	RES 1.62M 01% 1/8W PRES			EA	4.000
	2	201-178100	RES 1.78K 01% 1/8W PRES			EA	2.000
	2	201-178300	RES 178K 01% 1/8W PRES			EA	2.000
	2	201-196400	RES 1.96M 01% 1/8W PRES			EA	4.000
	2	201-200000	RES 200 01% 1/8W PRES			EA	2.000
	2	201-200100	RES 2K 01% 1/8W PRES			EA	2.000
	2	201-200200	RES 20K 01% 1/8W PRES			EA	2.000
	2	201-249000	RES 249 01% 1/8W PRES			EA	4.000
	2	201-249100	RES 2.49K 01% 1/8W PRES			EA	2.000
	2	201-249200	RES 24.9K 01% 1/8W PRES			EA	2.000
	2	201-316100	RES 3.16K 01% 1/8W PRES			EA	2.000
	2	201-412100	RES 4.12K 01% 1/8W PRES			EA	4.000
	2	201-499000	RES 499 01% 1/8W PRES			EA	8.000
	2	201-499100	RES 4.99K 01% 1/8W PRES			EA	6.000
	2	201-825100	RES 8.25K 01% 1/8W PRES			EA	6.000
	1	415-010800	204A MEMORY BD			EA	1.000
	2	000-906701	PCB/204A MEMORY	X		EA	1.000
	2	021-708800	TRN NPN 2N5301 40V 200W D MOT			EA	1.000
	2	022-700800	DIO RECT 1N4004 400V 1A G TXI			EA	1.000
	2	022-707100	DIO TRRM 3SM2 200V 2A G SEM			EA	1.000
	2	022-714100	DIO SCHT HSCH1001 60V15MAG HPC			EA	1.000
	2	022-715900	DIO SCHT VSK540 40V 5A G VAR			EA	2.000
	2	023-700200	CAP 1000PF 300V 5% MICA R ARC			EA	1.000
	2	023-701600	CAP 2.2MF 20V 10% TANT G KEM			EA	1.000
	2	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	18.000
	2	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	4.000
	2	023-711200	CAP 220MF 10V 10% TANT G KEM			EA	1.000
	2	023-711300	CAP .1MF 250V 10% PLYE R SEC			EA	1.000
	2	023-715100	CAP .05MF 50V CERM R ARC			EA	9.000
	2	024-715900	CON/16F DIP/SOL AMP 640358-3			EA	32.000
	2	024-727000	CON/6M REC/CRP AMP 1-350234-9			EA	1.000
	2	024-739900	CONN/MOLEX 22-16-2051			EA	1.000
	2	025-734800	SW/SL 2P2T CK 1101M2AB			EA	2.000
	2	032-700800	INSUL/DIODE			EA	1.000
	2	034-715500	GUIDE/SCANBE 11633-1			EA	4.000
	2	085-708600	CBL/34 COND/AP 922541-34-99-3			EA	2.000
	2	098-700400	HT SNK/P.C.B. COOLER			EA	1.000
	2	100-700700	RES NET/CSP10E-01-502J			EA	1.000
	2	103-010100	RES 100 05% 1W			EA	1.000
	2	108-010000	RES 10 05% 1/4W			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-003500			204A PLUG-IN				1
	2	100-015200	RES 1.5K 05% 1/4W			EA	1.000
	2	100-022300	RES 22K 05% 1/4W			EA	2.000
	2	121-702600	REG 2T038V .15A LAS1000 A LAM			EA	1.000
	2	134-711203	IC/74S74N FLIP-FLOP			EA	1.000
	2	134-723903	IC/74LS257 MULTIPLEXER			EA	5.000
	2	134-724903	IC/74S169 COUNTER			EA	3.000
	2	134-737400	IC/P2115AL			EA	32.000
	2	134-739003	IC/74S374N REGISTER			EA	2.000
	2	134-739103	IC/74LS244N OCTAL BUFFER			EA	6.000
	2	134-739203	IC/74S32N 2-OR			EA	2.000
	2	134-739303	IC/74S139N DEMULTIPLEXER			EA	1.000
	2	134-739403	IC/74S157N MULTIPLEXER			EA	2.000
	2	201-169100	RES 1.69K 01% 1/8W PRES			EA	1.000
	2	201-237100	RES 2.37K 01% 1/8W PRES			EA	1.000
	2	201-316100	RES 3.16K 01% 1/8W PRES			EA	1.000
	2	201-825000	RES 825 01% 1/8W PRES			EA	1.000
	1	415-010900	204A CONTROL BD			EA	1.000
	2	000-906601	PCB/204A CONTROL	X		EA	1.000
	2	022-709400	DIO TRRF 1N4150 50V .2A G TXI			EA	1.000
	2	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	4.000
	2	023-706800	CAP 150PF 500V 5% MICA R ARC			EA	1.000
	2	023-707500	CAP 6.8MF 35V 10% TANT G KEM			EA	4.000
	2	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	4.000
	2	023-711200	CAP .22MF 10V 10% TANT G KEM			EA	2.000
	2	023-711300	CAP .1MF 250V 10% PLYE R SEC			EA	2.000
	2	023-715100	CAP .05MF 50V CERM R ARC			EA	23.000
	2	023-716400	CAP 12PF 300V 5% MICA R ARC			EA	1.000
	2	023-717000	CAP 3PF 300V 16% MICA R ARC			EA	1.000
	2	023-717500	CAP 28KMF 15V ALUM S MEP			EA	1.000
	2	023-718200	CAP 27PF 300V 5% MICA R ARL			EA	1.000
	2	023-719600	CAP 18PF 300V 5% MICA R ARC			EA	2.000
	2	024-715900	CON/16F DIP/SOL AMP 640358-3			EA	6.000
	2	024-740800	CONN/2 PIN/6010-22-18-2023			EA	1.000
	2	025-717000	SW/ROT/32 POS.			EA	1.000
	2	034-711100	GUIDE/SCANBE 11633-1			EA	4.000
	2	040-707900	CLIP/RICHCO V-1011			EA	1.000
	2	085-708800	CBL/26 COND/AP 922521-26-99-3			EA	1.000
	2	085-708900	CBL/20 COND/AP 922521-20-99-03			EA	2.000
	2	085-709300	CBL/10 & 34 COND/AP 204A INTER	X		EA	1.000
	2	098-705300	HT SNK/6072B			EA	1.000
	2	100-000000	RES METALLIZED 01 502J			EA	3.000
	2	100-000000	RES METALLIZED 01 500J			EA	8.000
	2	100-000000	RES 10 1/8W			EA	1.000
	2	100-000000	RES 1K 1/8W			EA	5.000
	2	100-000000	RES 10K 1/8W			EA	7.000
	2	100-000000	RES 100K 1/8W			EA	1.000
	2	100-000000	RES 1M 1/8W			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-003500			204A PLUG-IN				1
	2.....	108-047100	RES 470 05% 1/4W			EA	1.000
	2.....	108-056000	RES 56 05% 1/4W			EA	2.000
	2.....	108-082200	RES 8.2K 05% 1/4W			EA	3.000
	2.....	121-701400	REG 2.5 TO 32V .1A 1469R D MOT			EA	1.000
	2.....	134-711203	IC/74S74N FLIP-FLOP			EA	5.000
	2.....	134-712803	IC/74LS00N 2-NAND			EA	3.000
	2.....	134-713203	IC/74LS74N FLIP-FLOP			EA	2.000
	2.....	134-713703	IC/74LS253N MULTIPLEXER			EA	2.000
	2.....	134-713900	IC/MK5009P MOS LSI			EA	1.000
	2.....	134-715503	IC/74LS153N MULTIPLEXER			EA	2.000
	2.....	134-716003	IC/74S86 2-XOR			EA	1.000
	2.....	134-716803	IC/74123N MONOSTABLE			EA	1.000
	2.....	134-718303	IC/74S02N 2-NOR			EA	1.000
	2.....	134-718803	IC/74LS175N REGISTER			EA	1.000
	2.....	134-719403	IC/74LS151N MULTIPLEXER			EA	4.000
	2.....	134-719503	IC/74S288N PROM			EA	1.000
	2.....	134-720503	IC/74LS174N REGISTER			EA	2.000
	2.....	134-720803	IC/74LS10N 3-NAND			EA	1.000
	2.....	134-722703	IC/74LS08N 2-AND			EA	1.000
	2.....	134-723903	IC/74LS257 MULTIPLEXER			EA	3.000
	2.....	134-724903	IC/74S169 COUNTER			EA	2.000
	2.....	134-730903	IC/74LS367N HEX DRIVER			EA	1.000
	2.....	134-731603	IC/74LS251N MULTIPLEXER			EA	1.000
	2.....	134-736003	IC/74S283J ADDER			EA	1.000
	2.....	134-738000	IC/F95L23DC			EA	2.000
	2.....	134-738200	IC/F10176DC ECL FLIP-FLOP			EA	1.000
	2.....	134-738400	IC/F10125PC ECL TRANSLATOR			EA	1.000
	2.....	134-738500	IC/F10010DC ECL DECADE COUNTER			EA	2.000
	2.....	134-738600	IC/F10106DC			EA	2.000
	2.....	134-738700	IC/F10115DC ECL RECEIVER			EA	1.000
	2.....	134-738800	IC/F10131DC ECL FLIP-FLOP			EA	5.000
	2.....	134-738900	IC/F10124PC ECL TRANSLATOR			EA	1.000
	2.....	134-739203	IC/74S32N 2-OR			EA	1.000
	2.....	134-739403	IC/74S157N MULTIPLEXER			EA	1.000
	2.....	191-705600	CRYS/100 MHZ .0025%			EA	1.000
	2.....	201-150000	RES 150 01% 1/8W PRES			EA	1.000
	2.....	201-249000	RES 249 01% 1/8W PRES			EA	1.000
	1.....	465-002700	204A FRONT PANEL			EA	1.000
	2.....	011-900300	BRKT/204A FRONT RETAINER	X		EA	1.000
	2.....	022-716600	DIO LEDG MV52124 2V 35MA L MON			EA	1.000
	2.....	024-721400	CON/1F CXL/SOL APH 31-010			EA	3.000
	2.....	035-701300	BUTT/PUSH CL J52305-04500			EA	9.000
	2.....	045-703500	KNOB/KPN-900BA-1/4"			EA	3.000
	2.....	045-703600	KNOB/KN-500BA-1/8"			EA	3.000
	2.....	068-900302	PAN/204A FRONT	X		EA	1.000
	2.....	068-900401	PAN/204A FRONT SUB	X		EA	1.000
	2.....	123-707400	MECH MISC/RECT LED ADAPTER			EA	1.000
	1.....	475-004000	204A MECHANICAL, MISC.			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
[illegible]			204a PLUG-IN				1
	2.....	011-728000	BRKT/204 SUPPORT	X		EA	1.000
	2.....	044-900001	SHIELD/204A ADC FRONT	X		EA	2.000
	2.....	044-900101	SHIELD/204A ADC REAR	X		EA	2.000
	2.....	044-900200	SHIELD/204A MEMORY BD	X		EA	1.000
	2.....	044-900300	SHIELD/204A TRIGGER BD	X		EA	1.000
	2.....	085-705400	PROBE/COLINE 900-90-505			EA	2.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-001900			206-1 PLUG-IN				1
	1.....	415-005900	206 CONTROL BD			EA	1.000
	2.....	000-901206	PCB/206 CONTROL	X		EA	1.000
	2.....	021-702700	TRANSIS/2N4265			EA	2.000
	2.....	022-706000	DIODE/REG/MBD-101			EA	2.000
	2.....	023-029200	CAP/22MF 10% 15V TANT AXL			EA	1.000
	2.....	023-700100	CAP/100PF 5% 500V MICA RAD			EA	2.000
	2.....	023-700300	CAP/500PF 5% 500V MICA RAD			EA	1.000
	2.....	023-700500	CAP/250PF 5% 500V MICA RAD			EA	1.000
	2.....	023-702400	CAP/.01MF 20% 100V CERM RAD			EA	5.000
	2.....	023-710600	CAP/10PF 10% 1000V CERM RAD			EA	1.000
	2.....	023-711100	CAP/4.7MF 10% 10V TANT AXL			EA	4.000
	2.....	023-715100	CAP/.05MF 50V CERM RAD			EA	5.000
	2.....	024-715900	CON/16F DIP/SOL AMP 640358-3			EA	2.000
	2.....	024-734000	CONN/IC SOC/20 PIN			EA	1.000
	2.....	025-727000	SW/ROT/32 POS.			EA	1.000
	2.....	100-700700	RES NET/CSP10E-01-502J			EA	2.000
	2.....	108-010000	RES/10 OHM/1/4W/5%			EA	3.000
	2.....	108-010200	RES/1K/1/4W/5%			EA	2.000
	2.....	108-010300	RES/10K/1/4W/5%			EA	1.000
	2.....	108-015200	RES/1.5K/1/4W/5%			EA	1.000
	2.....	108-022100	RES/2200HM/1/4W/5%			EA	1.000
	2.....	108-022200	RES/2.2K/1/4W/5%			EA	2.000
	2.....	108-033200	RES/3.3K/1/4W/5%			EA	1.000
	2.....	108-047000	RES/470HM/1/4W/5%			EA	2.000
	2.....	108-047100	RES/4700HM/1/4W/5%			EA	1.000
	2.....	108-068100	RES/6800HM/1/4W/5%			EA	1.000
	2.....	134-701803	IC/7400N 2-NAND			EA	1.000
	2.....	134-710103	IC/74164N SHIFT REGISTER			EA	2.000
	2.....	134-711203	IC/74S74N FLIP-FLOP			EA	5.000
	2.....	134-712803	IC/74LS00N 2-NAND			EA	4.000
	2.....	134-712903	IC/74LS04N HEX INVERTER			EA	2.000
	2.....	134-713203	IC/74LS74N FLIP-FLOP			EA	11.000
	2.....	134-713703	IC/74LS253N MULTIPLEXER			EA	4.000
	2.....	134-713900	IC/MK5009P MOS LSI			EA	1.000
	2.....	134-715503	IC/74LS153N MULTIPLEXER			EA	2.000
	2.....	134-716203	IC/74S175N REGISTER			EA	1.000
	2.....	134-717403	IC/74S287N PROM			EA	1.000
	2.....	134-717903	IC/74LS86N 2-XOR			EA	1.000
	2.....	134-718803	IC/74LS175N REGISTER			EA	6.000
	2.....	134-719103	IC/74196N COUNTER			EA	1.000
	2.....	134-719403	IC/74LS151N MULTIPLEXER			EA	3.000
	2.....	134-719503	IC/74S288N PROM			EA	1.000
	2.....	134-720403	IC/74LS02N 2-NOR			EA	2.000
	2.....	134-722703	IC/74LS08N 2-AND			EA	2.000
	2.....	134-724900	IC/74S169 COUNTER			EA	2.000
	2.....	134-728803	IC/74S472 PROM			EA	1.000
	2.....	134-730903	IC/74LS367N HEX DRIVER			EA	4.000
	2.....	134-731603	IC/74LS251N MULTIPLEXER			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
805-001900			206-1 PLUG-IN				1
	2.....	191-704600	CRYS/HC18/U 40 MHZ .005			EA	1.000
	1.....	415-006000	206 STORAGE CONTROL BD			EA	1.000
	2.....	000-900806	PCB/206 STORAGE CONTROL			EA	1.000
	2.....	024-714400	CON/20F REC/IDP MMM 3421-0000			EA	2.000
	2.....	025-721600	SW/PB 1P2TM SH SRL/BLK/RED			EA	2.000
	2.....	025-726900	SW/PB/GREEN LED			EA	1.000
	2.....	025-727900	SW/GF-126-PC-G20-18			EA	3.000
	2.....	108-022100	RES/220OHM/1/4W/5%			EA	3.000
	2.....	108-022200	RES/2.2K/1/4W/5%			EA	3.000
	2.....	108-022300	RES/22K/1/4W/5%			EA	3.000
	1.....	415-006100	206 MEMORY BD			EA	1.000
	2.....	000-901403	PCB/206 MEMORY	X		EA	1.000
	2.....	023-711100	CAP/4.7MF 10% 10V TANT AXL			EA	5.000
	2.....	023-715100	CAP/.05MF 50V CERM RAD			EA	5.000
	2.....	134-717903	IC/74LS86N 2-XOR			EA	1.000
	2.....	134-722403	IC/74LS139N MULTIPLEXER			EA	1.000
	2.....	134-723903	IC/74LS257 MULTIPLEXER			EA	11.000
	2.....	134-724900	IC/74S169 COUNTER			EA	3.000
	2.....	134-725103	IC/2102LIDCQP			EA	48.000
	1.....	415-006200	206 MOTHER BD			EA	1.000
	2.....	000-901103	PCB/206 MOTHER	X		EA	1.000
	2.....	015-702700	PIN/350036-2 26.18 GA			EA	3.000
	2.....	021-706200	TRANSIS/E-230/SILICONIX			EA	2.000
	2.....	022-703800	DIODE/1N5234/ZENER/6.2V			EA	1.000
	2.....	022-709400	DIODE/1N4150			EA	3.000
	2.....	023-700200	CAP/1000PF 5% 300V MICA RAD			EA	2.000
	2.....	023-700300	CAP/500PF 5% 500V MICA RAD			EA	1.000
	2.....	023-702400	CAP/.01MF 20% 100V CERM RAD			EA	1.000
	2.....	023-706900	CAP/50MF 50V ALUM AXL			EA	1.000
	2.....	023-708000	CAP/3.3PF 15% 1000V CERM RAD			EA	2.000
	2.....	023-711100	CAP/4.7MF 10% 10V TANT AXL			EA	1.000
	2.....	023-713500	CAP/4.7MF 10% 50V TANT AXL			EA	4.000
	2.....	023-715100	CAP/.05MF 50V CERM RAD			EA	4.000
	2.....	024-733200	CON/6M HDR/SOL AMP 9-350259-2			EA	1.000
	2.....	024-737200	CONN/56PIN/AMP 67907.3			EA	2.000
	2.....	024-744700	CON/80F EDG/SOL MCP MP0125-40			EA	2.000
	2.....	108-010300	RES/10K/1/4W/5%			EA	2.000
	2.....	108-010400	RES/100K/1/4W/5%			EA	1.000
	2.....	108-010500	RES/1MEG/1/4W/5%			EA	1.000
	2.....	108-012300	RES/12K/1/4W/5%			EA	2.000
	2.....	108-015300	RES/15K/1/4W/5%			EA	2.000
	2.....	108-018300	RES/18K/1/4W/5%			EA	2.000
	2.....	108-022000	RES/22OHM/1/4W/5%			EA	4.000
	2.....	108-022100	RES/220UHM/1/4W/5%			EA	1.000
	2.....	108-022300	RES/22K/1/4W/5%			EA	3.000
	2.....	108-027100	RES/270OHM/1/4W/5%			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-001900			206-1 PLUG-IN				1
	2.....	108-047100	RES/4700HM/1/4W/5%			EA	1.000
	2.....	108-047300	RES/47K/1/4W/5%			EA	2.000
	2.....	108-068100	RES/6800HM/1/4W/5%			EA	1.000
	2.....	108-068200	RES/6.8K/1/4W/5%			EA	1.000
	2.....	108-082200	RES/8.2K/1/4W/5%			EA	2.000
	2.....	134-711900	IC/LM318H OPAMP			EA	2.000
	2.....	134-712703	IC/TCL820CN3			EA	1.000
	2.....	134-713203	IC/74LS74N FLIP-FLOP			EA	2.000
	2.....	134-716803	IC/74123N MONOSTABLE			EA	1.000
	2.....	134-723903	IC/74LS257 MULTIPLEXER			EA	1.000
	1.....	415-006300	EXTENDER BD/PLUG-IN			EA	1.000
	2.....	000-902301	PCB/EXTENDER BD/PLUG-IN	X		EA	1.000
	2.....	024-712500	CON/20F EDG/SOL CIN 2521030160			EA	1.000
	1.....	465-001600	206 FRONT PANEL			EA	1.000
	2.....	010-700900	NUT/BL ANODI W-NU-17D			EA	1.000
	2.....	011-721607	BRKT/MOTHER BD/EXPL	X		EA	1.000
	2.....	011-723400	BRKT/206 RETAINER	X		EA	1.000
	2.....	020-701808	CHAS/PLUG-IN			EA	1.000
	2.....	022-714500	DIODE/LED 406 GREEN			EA	1.000
	2.....	023-722600	CAP/.1MFD @ 250V 5%			EA	1.000
	2.....	024-058900	CON/1F CXL/SOL AFH F-UG 657-U			EA	1.000
	2.....	024-714400	CON/20F REC/IDP MMM 3421-0000			EA	1.000
	2.....	025-718000	SW/C + K #8531			EA	1.000
	2.....	025-727600	SW/CTS/#T202/2 POLE/2-5STA			EA	3.000
	2.....	026-710000	POT/100K/C.L. BA147-0134			EA	1.000
	2.....	034-713300	GUIDE/SCANBE #11633-4			EA	2.000
	2.....	045-703200	KNOB/KPN-500BA/1/8			EA	3.000
	2.....	045-703500	KNOB/KPN-900BA-1/4"			EA	1.000
	2.....	045-703600	KNOB/KN-500BA-1/8"			EA	1.000
	2.....	051-700100	BUMPER/SJ5004X			EA	3.000
	2.....	068-727708	PAN/206 FRONT			EA	1.000
	2.....	093-702200	FASTNR/STUD/PEM CFHC-632-4			EA	4.000
	2.....	093-702400	FASTNR/SCR 6-32 X 1/4" BLK			EA	4.000
	1.....	465-001700	BLANK PANEL/AMP			EA	1.000
	2.....	068-729700	PANEL/BLANK/D II AMP	X		EA	1.000
	1.....	475-001900	206 FINAL ASSEMBLY			EA	1.000
	2.....	034-714300	GUIDE/W/TAPE			EA	3.000
	2.....	042-711000	COVER/96B	X		EA	1.000
	2.....	044-705000	SHIELD/MEM BD/206	X		EA	1.000
	1.....	845-000200	DII AMP			EA	1.000
	2.....	415-005800	206/205 ADC BD			EA	1.000
	3.....	000-900904	PCB/206/205 ADC	X		EA	1.000
	3.....	021-701800	TRANSIS/2N3905			EA	2.000
	3.....	021-702200	TRANSIS/2N3903			EA	8.000
	3.....	021-704700	TRANSIS/2N5224/NPN/12V/.6MW			EA	5.000
	3.....	021-706300	TRANSIS/2N3906			EA	15.000
	3.....	022-711400	DIODE/REGULATOR 79GUIC			EA	2.000
	3.....	022-711500	DIODE/REGULATOR 78GUIC			EA	2.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-001900			206-1 PLUG-IN				1
	3.....	022-711600	DIODE/1N4376/.75 NS TRR/20V			EA	46.000
	3.....	022-714100	DIODE/HSCH 1001/SCHOTTKY			EA	16.000
	3.....	023-029200	CAP/22MF 10% 15V TANT AXL			EA	2.000
	3.....	023-701600	CAP/2.2MF 10% 20V TANT AXL			EA	2.000
	3.....	023-702400	CAP/.01MF 20% 100V CERM RAD			EA	4.000
	3.....	023-702700	CAP/.22MF 10% 35V TANT AXL			EA	2.000
	3.....	023-706700	CAP/390PF 5% 500V MICA RAD			EA	2.000
	3.....	023-706800	CAP/150PF 5% 500V MICA RAD			EA	1.000
	3.....	023-709100	CAP/20PF 5% 500V MICA RAD			EA	4.000
	3.....	023-711000	CAP/22MF 10% 35V TANT AXL			EA	1.000
	3.....	023-712200	CAP/.022MF 10% 200V PLYE AXL			EA	1.000
	3.....	023-717800	CAP/6PFD 300V			EA	5.000
	3.....	023-719700	CAP/2.2MFD 50V			EA	2.000
	3.....	024-715900	CON/16F DIP/SOL AMP 640358-3			EA	6.000
	3.....	026-705600	POT/2K PCB DAL 784-20-202			EA	1.000
	3.....	026-705700	POT/5K PCB DAL 784-20-502			EA	1.000
	3.....	026-706200	POT/50K PCB DAL 784-20-503			EA	5.000
	3.....	026-707700	POT/ET 14W-200 MEPCO			EA	5.000
	3.....	100-700900	RES NET/7X25K/.01%			EA	1.000
	3.....	108-010100	RES/100OHM/1/4W/5%			EA	3.000
	3.....	108-010200	RES/1K/1/4W/5%			EA	3.000
	3.....	108-010300	RES/10K/1/4W/5%			EA	13.000
	3.....	108-010400	RES/100K/1/4W/5%			EA	3.000
	3.....	108-015100	RES/150OHM/1/4W/5%			EA	1.000
	3.....	108-015300	RES/15K/1/4W/5%			EA	5.000
	3.....	108-022000	RES/220HM/1/4W/5%			EA	1.000
	3.....	108-022100	RES/220OHM/1/4W/5%			EA	1.000
	3.....	108-033200	RES/3.3K/1/4W/5%			EA	4.000
	3.....	108-039200	RES/3.9K/1/4W/5%			EA	3.000
	3.....	108-047000	RES/47OHM/1/4W/5%			EA	7.000
	3.....	108-047200	RES/4.7K/1/4W/5%			EA	6.000
	3.....	108-047300	RES/47K/1/4W/5%			EA	7.000
	3.....	108-068200	RES/6.8K/1/4W/5%			EA	6.000
	3.....	134-710203	IC/74LS83N ADDER			EA	3.000
	3.....	134-710403	IC/74S00N 2-NAND			EA	2.000
	3.....	134-712803	IC/74LS00N 2-NAND			EA	2.000
	3.....	134-718803	IC/74LS175N REGISTER			EA	10.000
	3.....	134-722303	IC/74LS298N REGISTER			EA	3.000
	3.....	134-722703	IC/74LS08N 2-AND			EA	2.000
	3.....	201-001000	RES/P 1/8W/1 OHM			EA	1.000
	3.....	201-100100	PRES/ 1/8W 1K			EA	7.000
	3.....	201-110200	PRES 1/8W /11.0K			EA	1.000
	3.....	201-124000	PRES 1/8W/124 OHMS			EA	2.000
	3.....	201-137000	PRES 1/8W /137 OHM			EA	3.000
	3.....	201-143000	PRES 1/8W /143 OHM			EA	2.000
	3.....	201-143200	PRES 1/8W/14.3K			EA	1.000
	.....	201-150000	PRES 1/8W/150 OHM			EA	7.000
	3.....	201-150300	PRE			EA	3.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-001900			206-1 PLUG-IN				1
	3.....	201-178000	RES/1/8W./178 OHM			EA	3.000
	3.....	201-200100	PRES 1/8W/2K IRC			EA	5.000
	3.....	201-200200	PRES 1/8W/20K I.R.C.			EA	1.000
	3.....	201-221100	PRES 1/8W/2.21K			EA	1.000
	3.....	201-249200	PRES 1/8W/24.9K			EA	22.000
	3.....	201-267900	PRES 1/8W /26.7 OHM			EA	1.000
	3.....	201-270100	RES P/2.7K 1% 1/8W			EA	1.000
	3.....	201-316100	PRES 1/8W/3.16K IRC			EA	1.000
	3.....	201-374100	PRES 1/8W/3.74K			EA	1.000
	3.....	201-374200	PRES 1/8W/37.4K			EA	1.000
	3.....	201-402000	PRES 1/8W/402 OHM IRC			EA	1.000
	3.....	201-499000	PRES 1/8W/499 OHM			EA	4.000
	3.....	201-499100	PRES 1/8W/4.99K			EA	1.000
	3.....	201-750100	PRES 1/8W/7.5K			EA	1.000
	3.....	201-806100	PRES/ 1/8W 8.06K 1%			EA	5.000
	3.....	201-887200	PRES 1/8W/88.7 K			EA	1.000
	2.....	415-006400	206/205 DII AMP B0			EA	1.000
	3.....	000-901004	PCB/206/205 DII AMP	X		EA	1.000
	3.....	021-704700	TRANSIS/2N5224/NPN/12V/.6MW			EA	1.000
	3.....	021-706300	TRANSIS/2N3906			EA	1.000
	3.....	023-029200	CAP/22MF 10% 15V TANT AXL			EA	1.000
	3.....	023-700200	CAP/1000PF 5% 300V MICA RAD			EA	2.000
	3.....	023-702400	CAP/.01MF 20% 100V CERM RAD			EA	4.000
	3.....	023-702800	CAP/.68MF 10% 35V TANT AXL			EA	1.000
	3.....	023-706800	CAP/150PF 5% 500V MICA RAD			EA	1.000
	3.....	023-710200	CAP/5.5-18PF 50V CERM RAD			EA	10.000
	3.....	023-710600	CAP/10PF 10% 1000V CERM RAD			EA	2.000
	3.....	023-711400	CAP/.0022MF 10% 200V PLYE AXL			EA	1.000
	3.....	023-712100	CAP/.01MF 10% 200V PLYE AXL			EA	2.000
	3.....	023-718100	CAP/150PF 5% 50V MICA RAD			EA	2.000
	3.....	023-722600	CAP/.1MFD @ 250V 5%			EA	1.000
	3.....	024-712500	CON/20F EDG/SOL CIN 2521030160			EA	1.000
	3.....	025-726700	SW/PB-15/3 STA/6 POLE C.I.			EA	1.000
	3.....	025-726800	SW/PB-10/3 STA/2 POLE C.L			EA	1.000
	3.....	026-705500	POT/1K PCB DAL 784-20-102			EA	2.000
	3.....	026-707700	POT/ET 14W-200 MEPCO			EA	3.000
	3.....	026-709800	POT/10K/MEPCO ET14-10K			EA	3.000
	3.....	026-709900	POT-25/MEPCO ET14-25			EA	2.000
	3.....	108-010100	RES/1000HM/1/4W/5%			EA	7.000
	3.....	108-010400	RES/100K/1/4W/5%			EA	2.000
	3.....	108-022200	RES/2.2K/1/4W/5%			EA	2.000
	3.....	108-022300	RES/22K/1/4W/5%			EA	1.000
	3.....	108-033400	RES/330K/1/4W/5%			EA	1.000
	3.....	108-047200	RES/4.7K/1/4W/5%			EA	3.000
	3.....	108-068100	RES/6800HM/1/4W/5%			EA	1.000
	3.....	108-082200	RES/8.2K/1/4W/5%			EA	1.000
	3.....	134-730600	IC/CA3140S OPAMP			EA	5.000
	3.....	201-100000	PRES 1/8W/100 OHMS MF5C 1/8W			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-001900			206-1 PLUG-IN				1.
	3.....	201-100200	PRES 1/8W/10K 1/8W			EA	6.000
	3.....	201-100300	PRES 1/8W/100K 1/8W			EA	2.000
	3.....	201-100400	PRES 1/8W/1. MEG 1/8W			EA	4.000
	3.....	201-105200	PRES 1/8W/10.5K			EA	1.000
	3.....	201-169200	PRES 1/8W/16.9K I.R.C.			EA	1.000
	3.....	201-249300	PRES 1/8W/249K I.R.C.			EA	1.000
	3.....	201-374100	PRES 1/8W/3.74K			EA	1.000
	3.....	201-374200	PRES 1/8W/37.4K			EA	1.000
	3.....	201-499100	PRES 1/8W/4.99K			EA	3.000
	3.....	201-887100	PRES/8.87K 1/8W			EA	1.000
	3.....	201-909300	PRES/909K/ 1/8 W/1%			EA	2.000
	3.....	214-422100	PRS/RES 4.22K .1% 1/8W			EA	2.000
	2.....	475-002100	206/205 DII AMP FINAL ASSY			EA	1.000
	3.....	024-058900	CON/1F CXL/SOL APH F-UG 657-U			EA	2.000
	3.....	025-705500	SW/SL 2P2T CW GF-126-G20-28			EA	1.000
	3.....	026-712200	POT/BD MTG/SK			EA	1.000
	3.....	035-701300	BUTT/PUSH CL J52305-04500			EA	6.000
	3.....	044-704504	SHIELD/D11 AMP	X		EA	1.000
	3.....	045-703600	KNOB/KN-500BA-1/8"			EA	1.000
	3.....	068-728105	PAN/FRT/D11 AMP	X		EA	1.000
	3.....	085-705400	PROBE/COLINE 900-90-505			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002000			206-2 PLUG IN				1
	1	415-005900	206 CONTROL BD			EA	1.000
	2	000-901207	PCB/206 CONTROL	X		EA	1.000
	2	021-702700	TRN NPN 2N4265 12V .35W B MOT			EA	2.000
	2	022-706000	DIO SCHT MBD101 4V .1A B MOT			EA	2.000
	2	023-029200	CAP 22MF 15V 10% TANT G KEM			EA	1.000
	2	023-700100	CAP 100PF 500V 5% MICA R ARC			EA	2.000
	2	023-700300	CAP 500PF 500V 5% MICA R ARC			EA	1.000
	2	023-700500	CAP 250PF 500V 5% MICA R ARC			EA	1.000
	2	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	5.000
	2	023-710600	CAP 10PF 1000V 10% CERM R CLB			EA	1.000
	2	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	4.000
	2	023-715100	CAP .05MF 50V CERM R ARC			EA	5.000
	2	024-715900	CON/16F DIP/SOL AMP 640358-3			EA	2.000
	2	024-734000	CONN/IC SOC/20 PIN			EA	1.000
	2	025-727000	SW/ROT/32 POS.			EA	1.000
	2	100-700700	RES NET/CSP10E-01-502J			EA	2.000
	2	108-010000	RES 10 05% 1/4W			EA	3.000
	2	108-010200	RES 1K 05% 1/4W			EA	2.000
	2	108-010300	RES 10K 05% 1/4W			EA	1.000
	2	108-015200	RES 1.5K 05% 1/4W			EA	1.000
	2	108-022100	RES 220 05% 1/4W			EA	1.000
	2	108-022200	RES 2.2K 05% 1/4W			EA	2.000
	2	108-033200	RES 3.3K 05% 1/4W			EA	1.000
	2	108-047000	RES 47 05% 1/4W			EA	2.000
	2	108-047100	RES 470 05% 1/4W			EA	1.000
	2	108-068100	RES 680 05% 1/4W			EA	1.000
	2	134-701803	IC/7400N 2-NAND			EA	1.000
	2	134-710103	IC/74164N SHIFT REGISTER			EA	2.000
	2	134-711203	IC/74S74N FLIP-FLOP			EA	5.000
	2	134-712803	IC/74LS00N 2-NAND			EA	4.000
	2	134-712903	IC/74LS04N HEX INVERTER			EA	2.000
	2	134-713203	IC/74LS74N FLIP-FLOP			EA	11.000
	2	134-713703	IC/74LS253N MULTIPLEXER			EA	4.000
	2	134-713900	IC/MK5009P MOS LSI			EA	1.000
	2	134-715503	IC/74LS153N MULTIPLEXER			EA	2.000
	2	134-716203	IC/74S175N REGISTER			EA	1.000
	2	134-717403	IC/74S287N PROM			EA	1.000
	2	134-717903	IC/74LS86N 2-XOR			EA	1.000
	2	134-718803	IC/74LS175N REGISTER			EA	6.000
	2	134-719103	IC/74196N COUNTER			EA	1.000
	2	134-719403	IC/74LS151N MULTIPLEXER			EA	3.000
	2	134-719503	IC/74S288N PROM			EA	1.000
	2	134-720403	IC/74LS02N 2-NOR			EA	2.000
	2	134-722703	IC/74LS08N 2-AND			EA	2.000
	2	134-724903	IC/74S169 COUNTER			EA	2.000
	2	134-728803	IC/74S472 PROM			EA	1.000
	2	134-730903	IC/74LS367N HEX DRIVER			EA	4.000
	2	134-731603	IC/74LS251N MULTIPLEXER			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002000			206-2 PLUG IN				1
	2	191-704600	CRYS/HC18/U 40 MHZ .005			EA	1.000
	1	415-006000	206 STORAGE CONTROL BD			EA	1.000
	2	000-900806	PCB/206 STORAGE CONTROL	X		EA	1.000
	2	025-726900	SW/PB/GREEN LED			EA	1.000
	2	025-733800	SW/PB 1P2TM SH SRUL/RED			EA	2.000
	2	035-701800	BUTT/RECT SH SRKL/BLK W/RED			EA	2.000
	2	085-708700	CBL/20 COND/AP 922531-20-99-3			EA	1.000
	2	108-022100	RES 220 05% 1/4W			EA	3.000
	2	108-022200	RES 2.2K 05% 1/4W			EA	3.000
	2	108-022300	RES 22K 05% 1/4W			EA	3.000
	1	415-006100	206 MEMORY BD			EA	1.000
	2	000-901404	PCB/206 MEMORY	X		EA	1.000
	2	009-711200	SPCR/1/2" RICHCO 1CBS-8N			EA	2.000
	2	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	5.000
	2	023-715100	CAP .05MF 50V CERM R ARC			EA	5.000
	2	134-717903	IC/74LS86N 2-XOR			EA	1.000
	2	134-722403	IC/74LS139N MULTIPLEXER			EA	1.000
	2	134-723903	IC/74LS257 MULTIPLEXER			EA	11.000
	2	134-724903	IC/74S169 COUNTER			EA	3.000
	2	134-725103	IC/2102LIDCQP			EA	48.000
	1	415-006200	206 MOTHER BD			EA	1.000
	2	000-901103	PCB/206 MOTHER	X		EA	1.000
	2	015-702700	PIN/350036-2 26.18 GA			EA	3.000
	2	021-706200	TRN FETJN E230 40V .35W B SLX			EA	2.000
	2	022-703800	DIO ZENR 1N5234 6.2V .5W G MOT			EA	1.000
	2	022-709400	DIO TRRF 1N4150 50V .2A G TXI			EA	3.000
	2	023-700200	CAP 1000PF 300V 5% MICA R ARC			EA	2.000
	2	023-700300	CAP 500PF 500V 5% MICA R ARC			EA	1.000
	2	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	1.000
	2	023-706900	CAP 50MF 50V ALUM G SPG			EA	1.000
	2	023-708000	CAP 3.3PF 1000V 15% CERM R CLB			EA	2.000
	2	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	1.000
	2	023-713500	CAP 4.7MF 50V 10% TANT G KEM			EA	4.000
	2	023-715100	CAP .05MF 50V CERM R ARC			EA	4.000
	2	024-733200	CON/6M HDR/SOL AMP 9-350259-2			EA	1.000
	2	024-737200	CONN/56PIN/AMP 67907.3			EA	2.000
	2	024-744700	CON/80F EDG/SOL MCP MP0125-40			EA	2.000
	2	108-010300	RES 10K 05% 1/4W			EA	2.000
	2	108-010400	RES 100K 05% 1/4W			EA	1.000
	2	108-010500	RES 1M 05% 1/4W			EA	1.000
	2	108-012300	RES 12K 05% 1/4W			EA	2.000
	2	108-015600	RES 15K 05% 1/4W			EA	2.000
	2	108-018300	RES 18K 05% 1/4W			EA	2.000
	2	108-022000	RES 22 05% 1/4W			EA	4.000
	2	108-022100	RES 220 05% 1/4W			EA	1.000
	2	108-[illegible]	RES [illegible] 1/4W			EA	3.000
	2	[illegible]	[illegible]			[illegible]	[illegible]

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002000			206-2 PLUG IN				1
	2.....	108-033200	RES 3.3K 05% 1/4W			EA	2.000
	2.....	108-047100	RES 470 05% 1/4W			EA	1.000
	2.....	108-047300	RES 47K 05% 1/4W			EA	2.000
	2.....	108-068100	RES 680 05% 1/4W			EA	1.000
	2.....	108-068200	RES 6.8K 05% 1/4W			EA	1.000
	2.....	108-082200	RES 8.2K 05% 1/4W			EA	2.000
	2.....	134-711900	IC/LM318H OPAMP			EA	2.000
	2.....	134-712703	IC/TCL820CN3			EA	1.000
	2.....	134-713203	IC/74LS74N FLIP-FLOP			EA	2.000
	2.....	134-716803	IC/74123N MONOSTABLE			EA	1.000
	2.....	134-723903	IC/74LS257 MULTIPLEXER			EA	1.000
	1.....	415-006300	206 DII EXTENDER BD			EA	1.000
	2.....	000-902301	PCB/EXTENDER BD/PLUG-IN	X		EA	1.000
	2.....	024-712500	CON/20F EDG/SOL CIN 2521030160			EA	1.000
	1.....	465-001600	206 FRONT PANEL			EA	1.000
	2.....	010-700900	NUT/BL ANODI W-NU-17D			EA	1.000
	2.....	011-721607	BRKT/MOTHER BD/EXPL	X		EA	1.000
	2.....	011-723401	BRKT/206 RETAINER	X		EA	1.000
	2.....	020-701808	CHAS/PLUG-IN			EA	1.000
	2.....	022-714500	DIO LEDG 406G 1.9V 10MA M 1NM			EA	1.000
	2.....	023-711300	CAP .1MF 250V 10% PLYE R SEC			EA	1.000
	2.....	024-058900	CON/1F CXL/SOL APH F-UG 657-U			EA	1.000
	2.....	025-718000	SW/C + K #8531			EA	1.000
	2.....	025-727600	SW/CTS/#T202/2 POLE/2-5STA			EA	3.000
	2.....	025-727900	SW/GF-126-PC-G20-18			EA	3.000
	2.....	026-710000	POT/100K/C.L. BA147-0134			EA	1.000
	2.....	034-713300	GUIDE/SCANBE #11633-4			EA	2.000
	2.....	045-703200	KNOB/KPN-500BA/1/8			EA	3.000
	2.....	045-703500	KNOB/KPN-900BA-1/4"			EA	1.000
	2.....	045-703600	KNOB/KN-500BA-1/8"			EA	1.000
	2.....	051-700100	BUMPER/SJ5004X			EA	3.000
	2.....	068-727709	PAN/206 FRONT	X		EA	1.000
	2.....	068-740800	PAN/206 FRONT SUB	X		EA	1.000
	2.....	085-900100	CBL/20 COND/PLUG-IN FRONT	X		EA	1.000
	2.....	093-702400	FASTNR/SCR 6-32 X 1/4" BLK			EA	4.000
	1.....	475-001900	206 FINAL ASSEMBLY			EA	1.000
	2.....	034-714300	GUIDE/W/TAPE			EA	3.000
	2.....	042-711001	COVER/206 AMP DIVIDER	X		EA	1.000
	2.....	044-705001	SHIELD/206 MEMORY BD	X		EA	1.000
	1.....	845-000200	206 DII AMP/ADC			EA	2.000
	2.....	415-005800	206 ADC BD			EA	2.000
	3.....	000-900905	PCB/206 ADC	X		EA	2.000
	3.....	021-701800	TRN PNP 2N3905 40V .35W B MOT			EA	4.000
	3.....	021-702200	TRN NPN 2N3903 40V 1W B MOT			EA	16.000
	3.....	021-704700	TRN NPN 2N5224 12V .35W B MOT			EA	10.000
	3.....	021-706300	TRN PNP 2N3906 40V .625W B TXI			EA	30.000
	3.....	022-711600	DIO TRRF 1N4376 10V .05A G FCH			EA	92.000
	3.....	022-714100	DIO SCHT HSCH1001 60V15MAG HPC			EA	32.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002000			70s-2 PLUG IN				1
	3	023-029200	CAP 22MF 15V 10% TANT G KEM			EA	4.000
	3	023-701600	CAP 2.2MF 20V 10% TANT G KEM			EA	4.000
	3	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	8.000
	3	023-702700	CAP .22MF 35V 10% TANT G KEM			EA	4.000
	3	023-706700	CAP 390PF 500V 5% MICA R ARC			EA	4.000
	3	023-706800	CAP 150PF 500V 5% MICA R ARC			EA	2.000
	3	023-709100	CAP 20PF 500V 5% MICA R ARC			EA	8.000
	3	023-711000	CAP 22MF 35V 10% TANT G KEM			EA	2.000
	3	023-712200	CAP .022MF 200V 10% PLYE G SPG			EA	2.000
	3	023-717800	CAP 6PF 300V 8.3% MICA R ARC			EA	10.000
	3	023-719700	CAP 2.2MF 50V 10% TANT G KEM			EA	4.000
	3	024-715900	CON/16F DIP/SOL AMP 640358-3			EA	12.000
	3	026-705600	POT/2K PCB DAL 784-20-202			EA	2.000
	3	026-705700	POT/5K PCB DAL 784-20-502			EA	2.000
	3	026-706200	POT/50K PCB DAL 784-20-503			EA	10.000
	3	026-707700	POT/ET 14W-200 MEPCO			EA	10.000
	3	100-700900	RES NET/7X25K/.01%			EA	2.000
	3	108-010100	RES 100 05% 1/4W			EA	6.000
	3	108-010200	RES 1K 05% 1/4W			EA	6.000
	3	108-010300	RES 10K 05% 1/4W			EA	26.000
	3	108-010400	RES 100K 05% 1/4W			EA	6.000
	3	108-015100	RES 150 05% 1/4W			EA	2.000
	3	108-015300	RES 15K 05% 1/4W			EA	10.000
	3	108-022000	RES 22 05% 1/4W			EA	2.000
	3	108-022100	RES 220 05% 1/4W			EA	2.000
	3	108-033200	RES 3.3K 05% 1/4W			EA	8.000
	3	108-039200	RES 3.9K 05% 1/4W			EA	6.000
	3	108-047000	RES 47 05% 1/4W			EA	14.000
	3	108-047200	RES 4.7K 05% 1/4W			EA	12.000
	3	108-047300	RES 47K 05% 1/4W			EA	14.000
	3	108-068200	RES 6.8K 05% 1/4W			EA	12.000
	3	121-702700	REG 5 TO 30V .5A 78MGU1C E FCH			EA	4.000
	3	121-702800	REG -2.2/-30V.5A 79MGU1C E FCH			EA	4.000
	3	134-710203	IC/74LS83N ADDER			EA	6.000
	3	134-710403	IC/74S00N 2-NAND			EA	4.000
	3	134-712803	IC/74LS00N 2-NAND			EA	4.000
	3	134-718803	IC/74LS175N REGISTER			EA	20.000
	3	134-722303	IC/74LS298N REGISTER			EA	6.000
	3	134-722703	IC/74LS08N 2-AND			EA	4.000
	3	201-001000	RES 1 01% 1/8W PRES			EA	2.000
	3	201-100100	RES 1K 01% 1/8W PRES			EA	14.000
	3	201-110200	RES 11K 01% 1/8W PRES			EA	2.000
	3	201-124000	RES 124 01% 1/8W PRES			EA	4.000
	3	201-137000	RES 137 01% 1/8W PRES			EA	6.000
	3	201-143000	RES 143 01% 1/8W PRES			EA	4.000
	3	201-143700	RES 14.3K 01% 1/8W PRES			EA	2.000
	3	201-150000	RES 150 01% 1/8W PRES			EA	14.000
	3	201-170200	RES 130K 01% 1/8W PRES			EA	6.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002000			206-2 PLUG IN				1
	3.....	201-178000	RES 178 01% 1/8W PRES			EA	6.000
	3.....	201-200100	RES 2K 01% 1/8W PRES			EA	10.000
	3.....	201-200200	RES 20K 01% 1/8W PRES			EA	2.000
	3.....	201-221100	RES 2.21K 01% 1/8W PRES			EA	2.000
	3.....	201-249200	RES 24.9K 01% 1/8W PRES			EA	44.000
	3.....	201-267900	RES 26.7 01% 1/8W PRES			EA	2.000
	3.....	201-274100	RES 2.74K 01% 1/8W PRES			EA	2.000
	3.....	201-316100	RES 3.16K 01% 1/8W PRES			EA	2.000
	3.....	201-374100	RES 3.74K 01% 1/8W PRES			EA	2.000
	3.....	201-374200	RES 37.4K 01% 1/8W PRES			EA	2.000
	3.....	201-402000	RES 402 01% 1/8W PRES			EA	2.000
	3.....	201-499000	RES 499 01% 1/8W PRES			EA	8.000
	3.....	201-499100	RES 4.99K 01% 1/8W PRES			EA	2.000
	3.....	201-750100	RES 7.5K 01% 1/8W PRES			EA	2.000
	3.....	201-806100	RES 8.06K 01% 1/8W PRES			EA	10.000
	3.....	201-887200	RES 88.7K 01% 1/8W PRES			EA	2.000
	2.....	415-006400	206 DII AMP BD			EA	2.000
	3.....	000-901004	PCB/206 DII AMP	X		EA	2.000
	3.....	021-704700	TRN NPN 2N5224 12V .35W B MOT			EA	2.000
	3.....	021-706300	TRN PNP 2N3906 40V .625W B TXI			EA	2.000
	3.....	023-029200	CAP 22MF 15V 10% TANT G KEM			EA	2.000
	3.....	023-700100	CAP 100PF 500V 5% MICA R ARC			EA	4.000
	3.....	023-700200	CAP 1000PF 300V 5% MICA R ARC			EA	4.000
	3.....	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	8.000
	3.....	023-702800	CAP .68MF 35V 10% TANT G KEM			EA	2.000
	3.....	023-706800	CAP 150PF 500V 5% MICA R ARC			EA	2.000
	3.....	023-710200	CAP 5.5 TO 18PF 50V CERM STT			EA	20.000
	3.....	023-710600	CAP 10PF 1000V 10% CERM R CLB			EA	4.000
	3.....	023-711300	CAP .1MF 250V 10% PLYE R SEC			EA	2.000
	3.....	023-711400	CAP .0022MF 200V 10%PLYE G SPG			EA	2.000
	3.....	023-712100	CAP .01MF 200V 10% PLYE G SPG			EA	4.000
	3.....	024-712500	CON/20F EDG/SOL CIN 25210301G0			EA	2.000
	3.....	025-726700	SW/PB-15/3 STA/6 POLE C.L.			EA	2.000
	3.....	025-726800	SW/PB-10/3 STA/2 POLE C.L			EA	2.000
	3.....	026-705500	POT/1K PCB DAL 784-20-102			EA	4.000
	3.....	026-707700	POT/ET 14W-200 MEPCO			EA	6.000
	3.....	026-709800	POT/10K/MEPCO ET14-10K			EA	6.000
	3.....	026-709900	POT-25/MEPCO ET14-25			EA	4.000
	3.....	108-010100	RES 100 05% 1/4W			EA	14.000
	3.....	108-010400	RES 100K 05% 1/4W			EA	4.000
	3.....	108-022200	RES 2.2K 05% 1/4W			EA	4.000
	3.....	108-022300	RES 22K 05% 1/4W			EA	2.000
	3.....	108-033400	RES 330K 05% 1/4W			EA	2.000
	3.....	108-047200	RES 4.7K 05% 1/4W			EA	6.000
	3.....	108-068100	RES 680 05% 1/4W			EA	2.000
	3.....	108-082200	RES 8.2K 05% 1/4W			EA	2.000
	3.....	134-730600	IC/CA3140S OPAMP			EA	10.000
	3.....	201-100000	RES 100 01% 1/8W PRES			EA	2.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002000			206-2 PLUG IN				1
	3	201-100200	RES 10K 01% 1/8W PRES			EA	12.000
	3	201-100300	RES 100K 01% 1/8W PRES			EA	4.000
	3	201-100400	RES 1M 01% 1/8W PRES			EA	8.000
	3	201-105200	RES 10.5K 01% 1/8W PRES			EA	2.000
	3	201-169200	RES 16.9K 01% 1/8W PRES			EA	2.000
	3	201-249300	RES 249K 01% 1/8W PRES			EA	2.000
	3	201-374100	RES 3.74K 01% 1/8W PRES			EA	2.000
	3	201-374200	RES 37.4K 01% 1/8W PRES			EA	2.000
	3	201-499100	RES 4.99K 01% 1/8W PRES			EA	6.000
	3	201-825100	RES 8.25K 01% 1/8W PRES			EA	2.000
	3	201-909300	RES 909K 01% 1/8W PRES			EA	4.000
	3	214-422100	RES 4.22K .1% 1/8W PRES			EA	4.000
	2	475-002100	206 DII AMP FINAL ASSEMBLY			EA	2.000
	3	024-058900	CON/1F CXL/SOL APH F-UG 657-U			EA	4.000
	3	025-705500	SW/SL 2P2T CW GF-126-G20-28			EA	2.000
	3	026-712200	POT/5K PCB BRS 83C1D-E20-J13-5			EA	2.000
	3	035-701300	BUTT/PUSH CL J52305-04500			EA	12.000
	3	044-704504	SHIELD/D11 AMP	X		EA	2.000
	3	045-703600	KNOB/KN-500BA-1/8"			EA	2.000
	3	068-728108	PAN/206 DII FRONT	X		EA	2.000
	3	085-705400	PROBE/COLINE 900-90-505			EA	2.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
085-001600			2090-2 EXPLORER II				1
	1.....	415-004900	2090 MAIN FRAME BD			EA	1.000
	2.....	000-900301	PCB/MAIN FRAME/EXP SERIES	X		EA	1.000
	2.....	021-702500	TRN NPN 2N3302 30V .36W A MOT			EA	2.000
	2.....	022-701100	DIO GERM 1N270 80V .2A G ITT			EA	5.000
	2.....	023-701600	CAP 2.2MF 20V 10% TANT G KEM			EA	2.000
	2.....	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	2.000
	2.....	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	9.000
	2.....	023-711300	CAP .1MF 250V 10% PLYE R SEC			EA	7.000
	2.....	024-715900	CON/16F DIP/SOL AMP 640358-3			EA	1.000
	2.....	024-721300	CON/24F DIP/SOL AMP 640361-3			EA	2.000
	2.....	024-724800	CON/40F DIP/SOL AMP 640379-3			EA	3.000
	2.....	024-734000	CONN/IC SOC/20 PIN			EA	5.000
	2.....	024-737200	CONN/56PIN/AMP 67907.3			EA	1.000
	2.....	026-705500	POT/1K PCB DAL 784-20-102			EA	2.000
	2.....	100-700700	RES NET/CSP10E-01-502J			EA	3.000
	2.....	108-010300	RES 10K 05% 1/4W			EA	1.000
	2.....	108-010400	RES 100K 05% 1/4W			EA	1.000
	2.....	108-039100	RES 390 05% 1/4W			EA	6.000
	2.....	108-047200	RES 4.7K 05% 1/4W			EA	11.000
	2.....	108-047300	RES 47K 05% 1/4W			EA	1.000
	2.....	121-700900	REG -15V .35A 79M15AUC E FCH			EA	1.000
	2.....	134-705703	IC/741CP			EA	2.000
	2.....	134-712903	IC/74LS04N HEX INVERTER			EA	1.000
	2.....	134-713203	IC/74LS74N FLIP-FLOP			EA	6.000
	2.....	134-713703	IC/74LS253N MULTIPLEXER			EA	1.000
	2.....	134-717403	IC/74S287N PROM			EA	1.000
	2.....	134-718503	IC/74S182N CARRY LOOKAHEAD			EA	1.000
	2.....	134-720503	IC/74LS174N REGISTER			EA	4.000
	2.....	134-724500	IC/DAC80-CBI-V 12BIT DAC			EA	2.000
	2.....	134-724903	IC/74S169 COUNTER			EA	3.000
	2.....	134-728803	IC/74S472 PROM			EA	5.000
	2.....	134-730903	IC/74LS367N HEX DRIVER			EA	6.000
	2.....	134-731003	IC/74LS138N MULTIPLEXER			EA	3.000
	2.....	134-731603	IC/74LS251N MULTIPLEXER			EA	2.000
	2.....	134-732100	IC/96L02 MONOSTABLE			EA	1.000
	2.....	134-734300	IC/2901A 4BIT SLICE			EA	3.000
	1.....	415-005000	2090 BLANKING BD			EA	1.000
	2.....	000-900202	PCB/2090 BLANKING	X		EA	1.000
	2.....	015-706400	PIN/350665-2 AMP SPOOL			EA	12.000
	2.....	017-704200	LABEL/HI VOLT/EXPL	X		EA	1.000
	2.....	021-700600	TRN NPN 2N2484 60V .36W A MOT			EA	4.000
	2.....	021-702200	TRN NPN 2N3903 40V 1W B MOT			EA	1.000
	2.....	021-711100	TRN NPN MPSU10 300V 1W E MOT			EA	4.000
	2.....	021-711400	TRN FETP M113 30V .22W A SLX			EA	1.000
	2.....	022-700800	DIO RECT 1N4004 400V 1A G TXI			EA	1.000
	2.....	022-711600	DIO TRRF 1N4376 10V .05A G FCH			EA	1.000
	2.....	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	2.000
	2.....	023-707500	CAP 6.8MF 35V 10% TANT G KEM			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-001600			2090-2 EXPLORER II				1
	2	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	1.000
	2	023-711300	CAP .1MF 250V 10% PLYE R SEC			EA	6.000
	2	023-719400	CAP .01MF 3000V 20% CERM R SPG			EA	2.000
	2	024-719900	CON/15F REC/CRP AMP 1-350244-9			EA	1.000
	2	024-724600	CON/10F REC/IDP MMM 3473-6000			EA	1.000
	2	024-734900	CON/8M HDR/SOL BRG 65532-108			EA	2.000
	2	024-735900	CONN/10PIN/3M3474.0001T			EA	1.000
	2	026-705700	POT/5K PCB DAL 784-20-502			EA	5.000
	2	026-705900	POT/500K PCB DAL 784-20-504			EA	1.000
	2	026-706400	POT/1MEG PCB DAL 784-20-105			EA	1.000
	2	032-700600	INSUL/TRANSIS PAD			EA	4.000
	2	042-711400	COVER/BLANK-2090	X		EA	1.000
	2	042-712600	COVER/BLANKING BD	X		EA	1.000
	2	105-022300	RES 22K 05% 2W			EA	2.000
	2	105-027300	RES 27K 05% 2W			EA	2.000
	2	108-010500	RES 1M 05% 1/4W			EA	1.000
	2	108-022200	RES 2.2K 05% 1/4W			EA	1.000
	2	108-022300	RES 22K 05% 1/4W			EA	2.000
	2	108-022400	RES 220K 05% 1/4W			EA	1.000
	2	108-047100	RES 470 05% 1/4W			EA	2.000
	2	108-047200	RES 4.7K 05% 1/4W			EA	1.000
	2	108-056000	RES 56 05% 1/4W			EA	1.000
	2	134-729400	IC/6N137			EA	1.000
	2	201-100300	RES 100K 01% 1/8W PRES			EA	2.000
	2	201-127300	RES 127K 01% 1/8W PRES			EA	3.000
	2	201-165200	RES 16.5K 01% 1/8W PRES			EA	1.000
	2	201-200200	RES 20K 01% 1/8W PRES			EA	3.000
	2	201-200300	RES 200K 01% 1/8W PRES			EA	4.000
	2	201-243200	RES 24.3K 01% 1/8W PRES			EA	1.000
	2	201-249100	RES 2.49K 01% 1/8W PRES			EA	1.000
	2	201-499200	RES 49.9K 01% 1/8W PRES			EA	1.000
	2	201-750200	RES 75K 01% 1/8W PRES			EA	1.000
	2	201-976200	RES 97.6K 01% 1/8W PRES			EA	1.000
	1	415-007000	2090 4K MEMORY BD			EA	1.000
	2	000-900402	P.C.B./2090 MEMORY 4K	X		EA	1.000
	2	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	1.000
	2	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	4.000
	2	024-734400	CON/18F DIP/SOL AMP 640359-3			EA	13.000
	2	024-737200	CONN/56PIN/AMP 67907.3			EA	1.000
	2	100-700700	RES NET/CSP10E-01-502J			EA	1.000
	2	108-047100	RES 470 05% 1/4W			EA	1.000
	2	134-725003	IC/74LS14N HEX INVERTER			EA	1.000
	2	134-723903	IC/74LS257 MULTIPLEXER			EA	4.000
	2	134-730903	IC/74LS367N HEX DRIVER			EA	3.000
	2	[illegible]	IC/74LS374N REGISTER			EA	4.000
	2	[illegible]	IC/74LS241N OCTAL BUFFER			EA	3.000
	2	[illegible]	[illegible]			EA	3.000
	1	[illegible]	[illegible]			EA	1

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
985-001600			2090-2 EXPLORER II				1
	2.....	000-900500	PCB/INTERFACE BD/2090	X		EA	1.000
	2.....	024-725000	CON/12M HDR/SOL AMP 9-350264-1			EA	1.000
	2.....	085-707800	CBL/50 COND/13 IN./SPEC			EA	1.000
	1.....	465-001400	2090 FRONT PANEL			EA	1.000
	2.....	011-723001	BRKT/2090 STRAIN RELIEF	X		EA	1.000
	2.....	015-706300	PIN/350663-6 AMP SPOOL			EA	4.000
	2.....	017-704600	LABEL/LOGO/JEWEL			EA	1.000
	2.....	022-714800	DIO LEDG FLV340 2.3V20MA L FCH			EA	1.000
	2.....	024-721700	CON/4M REC/CRP AMP 1-350233-9			EA	1.000
	2.....	025-715500	SW/PA166-011-0AA			EA	2.000
	2.....	025-718100	SW/7215J612ZCE-2 C&K			EA	2.000
	2.....	025-718500	SW/LB 2P2T LI 01-700155			EA	1.000
	2.....	025-721300	SW/TOGGLE #LFH-123			EA	2.000
	2.....	025-727100	SW/845773-SK-1			EA	1.000
	2.....	025-727200	SW/C & K SPDT 8121-J82			EA	1.000
	2.....	025-734300	SW/RO 1PL2-7PS CL PA166-025			EA	1.000
	2.....	045-703301	KNOB/KX-12322 1/8"			EA	4.000
	2.....	068-726905	PAN/2090 FRONT BAY 2	X		EA	1.000
	2.....	068-741001	PAN/2090 FRONT SUB BAY 2	X		EA	1.000
	2.....	085-900000	CBL/26 COND/2090 FRONT	X		EA	1.000
	2.....	093-702400	FASTNR/SCR 6-32 X 1/4" BLK			EA	4.000
	1.....	475-001400	2090-2 FINAL ASSY			EA	1.000
	2.....	011-724500	BRKT/FRAME GROUND/2090			EA	1.000
	2.....	017-704301	LABEL/2090-2	X		EA	1.000
	2.....	024-727000	CON/6M REC/CRP AMP 1-350234-9			EA	1.000
	2.....	026-707800	POT/BA811-6670C.L. 250K			EA	1.000
	2.....	042-710802	COVER/BOTTOM/EXPL II	X		EA	1.000
	2.....	042-712500	COVER/LINE VOLTAGE	X		EA	1.000
	2.....	042-712702	COVER/L SIDE-2090-2	X		EA	2.000
	2.....	051-700300	BUMPER/5025			EA	10.000
	2.....	085-703800	CORD/A/C/LINE P2392 SW			EA	1.000
	2.....	164-700500	GRAT/BLUE/EXPL.	X		EA	1.000
	2.....	268-703001	BEZEL/EXP SERIES	X		EA	1.000
	2.....	268-704200	MECH MISC/TILT STAND/8"			EA	1.000
	1.....	475-001600	2090-2 CABINET ASSY			EA	1.000
	2.....	010-701500	NUT/SQUARE .860" #8-32	X		EA	1.000
	2.....	024-740300	CONN/AMP 87499-3/2PIN			EA	1.000
	2.....	027-700600	C.R.T./82D14GH/AMPEREX			EA	1.000
	2.....	034-714701	RAIL/TOP CENTER/EXPL.	X		EA	1.000
	2.....	034-714803	RAIL/SIDE EXPL			EA	2.000
	2.....	034-714901	RAIL/CONN/EXPL	X		EA	2.000
	2.....	034-715401	RAIL/PLUG IN	X		EA	1.000
	2.....	034-716200	RAIL/EXP II SUPPORT	X		EA	1.000
	2.....	044-704305	SHIELD/2090 CRT	X		EA	1.000
	2.....	049-700100	HANDLE/VINYLUXE			EA	1.000
	2.....	129-900101	FRAME/2090 ROUNDED END	X		EA	4.000
	1.....	645-000400	2090 M.F.POWER SUPPLY			EA	1.000
	2.....	415-005300	2090 POWER SUPPLY BD			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-001600			2090-2 EXPLORER II				1
	3	000-900004	PCB/2090 REGULATOR	X		EA	1.000
	3	006-701400	WASH/NO J TEFLON			EA	2.000
	3	011-716401	BRKT/H.V. XFORMER 60HZ	X		EA	1.000
	3	011-720900	BRKT/INTEN. FOCUS/2090	X		EA	1.000
	3	011-721000	BRKT/PWR SPLY MTG/2090	X		EA	2.000
	3	011-723101	BRKT/HI VOLT XFORMER/EXPL	X		EA	1.000
	3	015-706400	PIN/350665-2 AMP SPOOL			EA	30.000
	3	017-704200	LABEL/HI VOLT/EXPL	X		EA	6.000
	3	019-706000	XFORMER/ITA-1552-11			EA	1.000
	3	019-707000	XFORMER/HV WINDING/EXPL2 3	X		EA	1.000
	3	021-703800	TRN NPN 2N5978 60V 75W E	MOT		EA	2.000
	3	021-708800	TRN NPN 2N5301 40V 200W D	MOT		EA	1.000
	3	022-700800	DIO RECT 1N4004 400V 1A G	TXI		EA	6.000
	3	022-705100	DIO ZENR 1N5268 82V .5W G	MOT		EA	1.000
	3	022-706900	DIO TRRF FM50 5KV .01A G	SEM		EA	2.000
	3	022-707000	DIO TRRF S2F 200V 1A G	SEM		EA	5.000
	3	022-711900	DIO BRID VE48X 400V 1A C	VAR		EA	1.000
	3	023-029200	CAP 22MF 15V 10% TANT G	KEM		EA	1.000
	3	023-700200	CAP 1000PF 300V 5% MICA R	ARC		EA	1.000
	3	023-702800	CAP .68MF 35V 10% TANT G	KEM		EA	1.000
	3	023-704700	CAP 1MF 35V 10% TANT G	KEM		EA	2.000
	3	023-706900	CAP 50MF 50V ALUM G	SPG		EA	1.000
	3	023-707300	CAP 1MF 200V 10% MYLR G	TRW		EA	2.000
	3	023-711200	CAP 220MF 10V 10% TANT G	KEM		EA	1.000
	3	023-713500	CAP 4.7MF 50V 10% TANT G	KEM		EA	2.000
	3	023-719400	CAP .01MF 3000V 20% CERM R	SPG		EA	5.000
	3	023-719700	CAP 2.2MF 50V 10% TANT G	KEM		EA	5.000
	3	024-719600	CON/15M HDR/SOL AMP 9-350268-1			EA	1.000
	3	024-722500	CON/12F REC/CRP AMP 1-350243-9			EA	2.000
	3	024-723400	CON/2M HDR/SOL AMP 9-350360-1			EA	1.000
	3	024-726900	CON/6F REC/CRP AMP 1-350241-9			EA	1.000
	3	026-705400	POT/500 PCB DAL 784-20-501			EA	5.000
	3	026-706000	POT/20K PCB DAL 784-20-203			EA	1.000
	3	026-706500	POT/BRNS 500K			EA	2.000
	3	032-700800	INSUL/DIODE			EA	1.000
	3	032-700900	INSUL/DIODE			EA	7.000
	3	044-704600	SHIELD/H.V. EXPL.	X		EA	1.000
	3	067-700300	CORE/E1960-S-011A			EA	2.000
	3	079-703400	FUSE/.75 A/276.750 LITTLEFUSE			EA	1.000
	3	079-700000	THERMOS/165 DEG 7BTL6B10			EA	1.000
	3	098-700200	HT SNK/207CB W			EA	1.000
	3	098-704000	HT SNK/EXPL P.S.	X		EA	1.000
	3	098-704300	HT SNK	X		EA	1.000
	3	101-010500	RES 1M 10% 1/2W			EA	2.000
	3	101-022500	RES [illegible]			EA	2.000
	3	[illegible]	[illegible]			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-001600			2090-2 EXPLORER II				1
	3.....	108-010300	RES 10K 05% 1/4W			EA	1.000
	3.....	108-015300	RES 15K 05% 1/4W			EA	1.000
	3.....	108-022100	RES 220 05% 1/4W			EA	2.000
	3.....	108-027100	RES 270 05% 1/4W			EA	1.000
	3.....	108-033200	RES 3.3K 05% 1/4W			EA	1.000
	3.....	121-702100	REG 5 TO 30V 1A 78GU1C E FCH			CA	1.000
	3.....	121-702300	REG 1.2 TO 37V 1.5A 317T E NAT			EA	2.000
	3.....	121-702400	REG -1.2TO-37V 1.5A 337T E NAT			EA	2.000
	3.....	121-702600	REG 2TO38V ,15A LAS1000 A LAM			EA	1.000
	3.....	201-100300	RES 100K 01% 1/8W PRES			EA	1.000
	3.....	201-124000	RES 124 01% 1/8W PRES			EA	2.000
	3.....	201-200100	RES 2K 01% 1/8W PRES			EA	1.000
	3.....	201-200300	RES 200K 01% 1/8W PRES			EA	1.000
	3.....	201-221100	RES 2.21K 01% 1/8W PRES			EA	1.000
	3.....	201-249000	RES 249 01% 1/8W PRES			EA	2.000
	3.....	201-249100	RES 2.49K 01% 1/8W PRES			EA	1.000
	3.....	201-301000	RES 301 01% 1/8W PRES			EA	1.000
	3.....	201-365000	RES 365 01% 1/8W PRES			EA	1.000
	3.....	201-499100	RES 4.99K 01% 1/8W PRES			EA	2.000
	3.....	201-604000	RES 604 01% 1/8W PRES			EA	1.000
	3.....	201-619200	RES 61.9K 01% 1/8W PRES			EA	1.000
	3.....	201-825000	RES 825 01% 1/8W PRES			EA	1.000
	2.....	465-001200	2090 REAR PANEL BAY 2			EA	1.000
	3.....	015-706300	PIN/350663-6 AMP SPOOL			EA	12.000
	3.....	015-706400	PIN/350665-2 AMP SPOOL			EA	12.000
	3.....	019-708700	XFORMER/DJ346			EA	1.000
	3.....	024-711500	CON/5F CIR/SOL SWC 61HA5F			EA	1.000
	3.....	024-711600	CON/5M CIR/SOL SWC 12CL5M			EA	1.000
	3.....	024-721400	CON/1F CXL/SOL APH 31-010			EA	2.000
	3.....	024-721600	CON/4F REC/CRP AMP 1-350240-9			EA	1.000
	3.....	024-723300	CON/2F REC/CRF AMP 1-350354-9			EA	1.000
	3.....	024-724600	CON/10F REC/IDP MMM 3473-6000			EA	1.000
	3.....	024-726900	CON/6F REC/CRP AMP 1-350241-9			EA	1.000
	3.....	024-730800	CONN/15 PIN 1-350237-9			EA	1.000
	3.....	025-727500	SW/CW/GF-642			EA	2.000
	3.....	068-726608	PAN/2090 REAR BAY 2	X		EA	1.000
	3.....	070-701100	FUSE/348890 BODY			EA	1.000
	3.....	070-701200	FUSE/348007 CAP			EA	1.000
	3.....	102-700200	MOVISTOR/V130LA10A			EA	2.000
	3.....	114-701800	FLTR/6 AMP 6H9 CORCOM			EA	1.000
	2.....	465-001300	2090 REAR PANEL BAY 1			EA	1.000
	3.....	415-005200	2090 CAP BD P.S. BAY 1			EA	1.000
	4.....	000-900106	P.C.B./CAP BD/EXP SERIES	X		EA	1.000
	4.....	015-706300	PIN/350663-6 AMP SPOOL			EA	12.000
	4.....	015-706400	PIN/350665-2 AMP SPOOL			EA	12.000
	4.....	022-705300	D10 BRID VS647 600V 2A J VAR			EA	2.000
	4.....	023-716200	CAP 8800MF 25V ALUM S CAL			EA	2.000
	4.....	023-717500	CAP 28KMF 15V ALUM S MEF			EA	2.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
385-001600			2090-2 EXPLORER II				1
	4.....	023-719000	CAP 2000MF 50V ALUM S CAL			EA	2.000
	4.....	024-719900	CON/15F REC/CRP AMP 1-350244-9			EA	1.000
	4.....	024-721800	CON/12M REC/CRP AMP 1-350236-9			EA	1.000
	4.....	085-702400	CORD/428-=056 ROTRON			EA	1.000
	3.....	475-002500	MECH MISC/BAY 1 P.S.			EA	1.000
	4.....	022-713800	DIO RECT SCPE05 50V 5A Q SEM			EA	1.000
	4.....	068-726706	PAN/2090 REAR BAY 1	X		EA	1.000
	4.....	072-700100	FAN/WISPER WR2A1			EA	1.000
	4.....	114-702600	FLTR./FAN/PAMOTER#5502			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002100			2090-3A/DIGITAL I/O				1
	1.....	465-001900	DIGITAL I/O FRONT PANEL			EA	1.000
	2.....	022-713700	DIO LEDR 406-R 2V 10MA M INM			EA	1.000
	2.....	024-723300	CON/2F REC/CRP AMP 1-350354-9			EA	1.000
	2.....	068-727102	PAN/2090 FRONT BAY 3	X		EA	1.000
	1.....	845-000300	2090-3 MAIN FRAME			EA	1.000
	2.....	415-004900	2090 MAIN FRAME BD			EA	1.000
	3.....	000-900301	PCB/MAIN FRAME/EXP SERIES	X		EA	1.000
	3.....	021-702500	TRN NPN 2N3302 30V .36W A MOT			EA	2.000
	3.....	022-701100	DIO GERM 1N270 80V .2A G ITT			EA	5.000
	3.....	023-701600	CAP 2.2MF 20V 10% TANT G KEM			EA	2.000
	3.....	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	2.000
	3.....	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	9.000
	3.....	023-711300	CAP .1MF 250V 10% PLYE R SEC			EA	7.000
	3.....	024-715900	CON/16F DIP/SOL AMP 640358-3			EA	1.000
	3.....	024-721300	CON/24F DIP/SOL AMP 640361-3			EA	2.000
	3.....	024-724800	CON/40F DIP/SOL AMP 640379-3			EA	3.000
	3.....	024-734000	CONN/IC SOC/20 PIN			EA	5.000
	3.....	024-737200	CONN/56PIN/AMP 67907.3			EA	1.000
	3.....	026-705500	POT/1K PCB DAL 784-20-102			EA	2.000
	3.....	100-700700	RES NET/CSP10E-01-502J			EA	3.000
	3.....	108-010300	RES 10K 05% 1/4W			EA	1.000
	3.....	108-010400	RES 100K 05% 1/4W			EA	1.000
	3.....	108-039100	RES 390 05% 1/4W			EA	6.000
	3.....	108-047200	RES 4.7K 05% 1/4W			EA	11.000
	3.....	108-047300	RES 47K 05% 1/4W			EA	1.000
	3.....	121-700900	REG -15V .35A 79M15AUC E FCH			EA	1.000
	3.....	134-705703	IC/741CP			EA	2.000
	3.....	134-712903	IC/74LS04N HEX INVERTER			EA	1.000
	3.....	134-713203	IC/74LS74N FLIP-FLOP			EA	6.000
	3.....	134-713703	IC/74LS253N MULTIPLEXER			EA	1.000
	3.....	134-717403	IC/74S287N PROM			EA	1.000
	3.....	134-718503	IC/74S182N CARRY LOOKAHEAD			EA	1.000
	3.....	134-720503	IC/74LS174N REGISTER			EA	4.000
	3.....	134-724500	IC/DAC80-CBI-V 12BIT DAC			EA	2.000
	3.....	134-724903	IC/74S169 COUNTER			EA	3.000
	3.....	134-728803	IC/74S472 PROM			EA	5.000
	3.....	134-730903	IC/74LS367N HEX DRIVER			EA	6.000
	3.....	134-731003	IC/74LS138N MULTIPLEXER			EA	3.000
	3.....	134-731603	IC/74LS251N MULTIPLEXER			EA	2.000
	3.....	134-732100	IC/96L02 MONOSTABLE			EA	1.000
	3.....	134-734300	IC/2901A 4BIT SLICE			EA	3.000
	2.....	415-005000	2090 BLANKING BD			EA	1.000
	3.....	000-900202	PCB/2090 BLANKING	X		EA	1.000
	3.....	015-706400	PIN/350665-2 AMP SPOOL			EA	12.000
	3.....	017-704200	LABEL/HI VOLT/EXPL	X		EA	1.000
	3.....	021-700600	TRN NPN 2N2484 60V .36W A MOT			EA	4.000
	3.....	021-702200	TRN NPN 2N3903 40V 1W B MOT			EA	1.000
	3.....	021-711100	TRN NPN MPSU10 300V 1W E MOT			EA	4.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002100			2090-3A/DIGITAL I/O				1
	3	021-711400	TRN FETP M113 30V .22W A SLX			EA	1.000
	3	022-700000	DIO RECT 1N4004 400V 1A G TXI			EA	1.000
	3	022-711600	DIO TRRF 1N4376 10V .05A G FCH			EA	1.000
	3	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	2.000
	3	023-707500	CAP 6.8MF 35V 10% TANT G KEM			EA	1.000
	3	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	1.000
	3	023-711300	CAP .1MF 250V 10% PLYE R SEC			EA	6.000
	3	023-719400	CAP .01MF 3000V 20% CERM R SPG			EA	2.000
	3	024-719900	CON/15F REC/CRP AMP 1-350244-9			EA	1.000
	3	024-724600	CON/10F REC/IDP MMM 3473-6000			EA	1.000
	3	024-734900	CON/8M HDR/SOL BRG 65532-108			EA	2.000
	3	024-735900	CONN/10PIN/3M3474.0001T			EA	1.000
	3	026-705700	POT/5K PCB DAL 784-20-502			EA	5.000
	3	026-705900	POT/500K PCB DAL 784-20-504			EA	1.000
	3	026-706400	POT/1MEG PCB DAL 784-20-105			EA	1.000
	3	032-700600	INSUL/TRANSIS PAD			EA	4.000
	3	042-711400	COVER/BLANK-2090	X		EA	1.000
	3	042-712600	COVER/BLANKING BD	X		EA	1.000
	3	105-022300	RES 22K 05% 2W			EA	2.000
	3	105-027300	RES 27K 05% 2W			EA	2.000
	3	108-010500	RES 1M 05% 1/4W			EA	1.000
	3	108-022200	RES 2.2K 05% 1/4W			EA	1.000
	3	108-022300	RES 22K 05% 1/4W			EA	2.000
	3	108-022400	RES 220K 05% 1/4W			EA	1.000
	3	108-047100	RES 470 05% 1/4W			EA	2.000
	3	108-047200	RES 4.7K 05% 1/4W			EA	1.000
	3	108-056000	RES 56 05% 1/4W			EA	1.000
	3	134-729400	IC/6N137			EA	1.000
	3	201-100300	RES 100K 01% 1/8W PRES			EA	2.000
	3	201-127300	RES 127K 01% 1/8W PRES			EA	3.000
	3	201-165200	RES 16.5K 01% 1/8W PRES			EA	1.000
	3	201-200200	RES 20K 01% 1/8W PRES			EA	3.000
	3	201-200300	RES 200K 01% 1/8W PRES			EA	4.000
	3	201-243200	RES 24.3K 01% 1/8W PRES			EA	1.000
	3	201-249100	RES 2.49K 01% 1/8W PRES			EA	1.000
	3	201-499200	RES 49.9K 01% 1/8W PRES			EA	1.000
	3	201-750200	RES 75K 01% 1/8W PRES			EA	1.000
	3	201-976200	RES 97.6K 01% 1/8W PRES			EA	1.000
	2	415-007000	2090 4K MEMORY BD			EA	1.000
	3	000-900402	P.C.B./2090 MEMORY 4K	X		EA	1.000
	3	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	1.000
	3	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	4.000
	3	024-734400	CON/18F DIP/SOL AMP 640359-3			EA	13.000
	3	024-737200	CONN/50PIN AMP 67907.3			EA	1.000
	3	100-700700	RES [illegible]			EA	1.000
	3	108-047100	RES 470 1/4W			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002100			2090-3A/DIGITAL I/O				1
	3.....	134-730903	IC/74LS367N HEX DRIVER			EA	3.000
	3.....	134-736803	IC/74LS374N REGISTER			EA	4.000
	3.....	134-736903	IC/74LS241N OCTAL BUFFER			EA	3.000
	3.....	134-742300	IC/2141-2			EA	13.000
	2.....	415-007100	2090-3 INNER CONN BD 4K			EA	1.000
	3.....	000-900500	PCB/INTERFACE BD/2090	X		EA	1.000
	3.....	024-725000	CON/12M HDR/SOL AMP 9-350264-1			EA	1.000
	3.....	085-707900	CBL/50 COND/DAISY CHAIN			EA	1.000
	2.....	465-001400	2090 FRONT PANEL			EA	1.000
	3.....	011-723001	BRKT/2090 STRAIN RELIEF	X		EA	1.000
	3.....	015-706300	PIN/350663-6 AMP SPOOL			EA	4.000
	3.....	017-704600	LABEL/LOGO/JEWEL			EA	1.000
	3.....	022-714800	DIO LEDG FLV340 2.3V20MA L FCH			EA	1.000
	3.....	024-721700	CON/4M REC/CRP AMP 1-350233-9			EA	1.000
	3.....	025-715500	SW/PA166-011-0AA			EA	2.000
	3.....	025-718100	SW/7215J612ZCE-2 C&K			EA	2.000
	3.....	025-718500	SW/LB 2P2T LI 01-700155			EA	1.000
	3.....	025-721300	SW/TOGGLE #LFH-123			EA	2.000
	3.....	025-727100	SW/845773-SK-1			EA	1.000
	3.....	025-727200	SW/C & K SPDT 8121-J82			EA	1.000
	3.....	025-734300	SW/RO 1PL2-7PS CL PA166-025			EA	1.000
	3.....	045-703301	KNOB/KX-12322 1/8"			EA	4.000
	3.....	068-726905	PAN/2090 FRONT BAY 2	X		EA	1.000
	3.....	068-741001	PAN/2090 FRONT SUB BAY 2	X		EA	1.000
	3.....	085-900000	CBL/26 COND/2090 FRONT	X		EA	1.000
	3.....	093-702400	FASTNR/SCR 6-32 X 1/4" BLK			EA	4.000
	2.....	475-001500	2090-3 FINAL ASMB			EA	1.000
	3.....	011-724500	BRKT/FRAME GROUND/2090			EA	1.000
	3.....	017-704101	LABEL/2090-3	X		EA	1.000
	3.....	026-707800	POT/BA811-6670C.L. 250K			EA	1.000
	3.....	042-710903	COVER/BOTTOM/EXPL.III	X		EA	1.000
	3.....	042-712500	COVER/LINE VOLTAGE	X		EA	1.000
	3.....	042-712803	COVER/2090-3 L SIDE	X		EA	2.000
	3.....	051-700100	BUMPER/SJ5004X			EA	2.000
	3.....	051-700300	BUMPER/5025			EA	5.000
	3.....	085-703800	CORD/A/C/LINE F2392 SW			EA	1.000
	3.....	164-700500	GRAT/BLUE/EXPL.	X		EA	1.000
	3.....	268-703001	BEZEL/EXP SERIES	X		EA	1.000
	3.....	268-704300	MECH MISC/TILT STAND/14"			EA	1.000
	2.....	475-001700	2090-3 CAB ASMB			EA	1.000
	3.....	010-701500	NUT/SQUARE .860" #8-32	X		EA	1.000
	3.....	024-740300	CONN/AMP 87499-3/2PIN			EA	1.000
	3.....	027-700600	C.R.T./82D14GH/AMPEREX			EA	1.000
	3.....	034-714701	RAIL/TOP CENTER/EXPL.	X		EA	1.000
	3.....	034-714803	RAIL/SIDE EXPL			EA	2.000
	3.....	034-714901	RAIL/CONN/EXPL	X		EA	8.000
	3.....	034-715301	RAIL/CORNER SUPPORT	X		EA	1.000
	3.....	034-715401	RAIL/PLUG IN	X		EA	2.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002100			2090-3A/DIGITAL I/O				1
	3 . .	044-704[illegible]	SHIELD/2090 CRT	X		EA	1.000
	3	0[illegible]	MODULE/VINYLUXE			EA	1.000
	3	127-702100	FRAME/2090/END	X		EA	2.000
	3	127-700101	FRAME/2090 ROUNDED END	X		EA	4.000
	3	645-000400	2090 M.F.POWER SUPPLY			EA	1.000
	3	415-005300	2090 POWER SUPPLY BD			EA	1.000
	4	000-900004	PCB/2090 REGULATOR	X		EA	1.000
	4	006-701400	WASH/NO J TEFLON			EA	2.000
	4	011-716401	BRKT/H.V. XFORMER 60HZ	X		EA	1.000
	4	011-720900	BRKT/INTEN. FOCUS/2090	X		EA	1.000
	4	011-721000	BRKT/PWR SPLY MTG/2090	X		EA	2.000
	4	011-723101	BRKT/HI VOLT XFORMER/EXPL	X		EA	1.000
	4	015-706400	PIN/350665-2 AMP SPOOL			EA	30.000
	4	017-704200	LABEL/HI VOLT/EXPL	X		EA	6.000
	4	019-706000	XFORMER/ITA-1552-11			EA	1.000
	4	019-707000	XFORMER/HV WINDING/EXPL2 3	X		EA	1.000
	4	021-703800	TRN NPN 2N5978 60V 75W E MOT			EA	2.000
	4	021-708800	TRN NPN 2N5301 40V 200W D MOT			EA	1.000
	4	022-700800	DIO RECT 1N4004 400V 1A G TXI			EA	6.000
	4	022-705100	DIO ZENR 1N5268 82V .5W G MOT			EA	1.000
	4	022-706900	DIO TRRF FM50 5KV .01A G SEM			EA	2.000
	4	022-707000	DIO TRRF S2F 200V 1A G SEM			EA	5.000
	4	022-711900	DIO BRID VE48X 400V 1A C VAR			EA	1.000
	4	023-029200	CAP 22MF 15V 10% TANT G KEM			EA	1.000
	4	023-700200	CAP 1000PF 300V 5% MICA R ARC			EA	1.000
	4	023-702800	CAP .68MF 35V 10% TANT G KEM			EA	1.000
	4	023-704700	CAP 1MF 35V 10% TANT G KEM			EA	2.000
	4	023-706900	CAP 50MF 50V ALUM G SPG			EA	1.000
	4	023-707300	CAP 1MF 200V 10% MYLR G TRW			EA	2.000
	4	023-711200	CAP 220MF 10V 10% TANT G KEM			EA	1.000
	4	023-713500	CAP 4.7MF 50V 10% TANT G KEM			EA	2.000
	4	023-719400	CAP .01MF 3000V 20% CERM R SPG			EA	5.000
	4	023-719700	CAP 2.2MF 50V 10% TANT G KEM			EA	5.000
	4	024-719600	CON/15M HDR/SOL AMP 9-350268-1			EA	1.000
	4	024-722500	CON/12F REC/CRP AMP 1-350243-9			EA	2.000
	4	024-723400	CON/2M HDR/SOL AMP 9-350360-1			EA	1.000
	4	024-726900	CON/6F REC/CRP AMP 1-350241-9			EA	1.000
	4	026-705400	POT/500 PCB DAL 784-20-501			EA	5.000
	4	026-706000	POT/20K PCB DAL 784-20-203			EA	1.000
	4	026 706500	POT/BRNS 500K			EA	2.000
	4	[illegible]700800	INSUL/DIODE			EA	1.000
	4	[illegible]700900	INSUL/DIODE			EA	7.000
	4	044-704600	SHIELD/H.V. EXPL.			EA	1.000
	4	067-700300	CORE/E1960-S-011A			EA	2.000
	4	[illegible]703400	FUSE/.75 A/276.750 LITTLEFU.E			EA	1.000
	4	[illegible]00000	THERMOS/165 DEG 7BTL6B10			EA	1.000
	4						1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002100			2090-3A/DIGITAL I/O				1
	4.....	098-704300	HT SNK	X		EA	1.000
	4.....	101-010500	RES 1M 10% 1/2W			EA	2.000
	4.....	101-022500	RES 2.2M 10% 1/2W			EA	2.000
	4.....	105-012100	RES 120 05% 2W			EA	1.000
	4.....	106-703500	RES .1 05% 10W			EA	1.000
	4.....	106-703600	RES 200M 10% 1W			EA	1.000
	4.....	108-010300	RES 10K 05% 1/4W			EA	1.000
	4.....	108-015300	RES 15K 05% 1/4W			EA	1.000
	4.....	108-022100	RES 220 05% 1/4W			EA	2.000
	4.....	108-027100	RES 270 05% 1/4W			EA	1.000
	4.....	108-033200	RES 3.3K 05% 1/4W			EA	1.000
	4.....	121-702100	REG 5 TO 30V 1A 78GU1C E FCH			EA	1.000
	4.....	121-702300	REG 1.2 TO 37V 1.5A 317T E NAT			EA	2.000
	4.....	121-702400	REG -1.2TO-37V 1.5A 337T E NAT			EA	2.000
	4.....	121-702600	REG 2TO38V .15A LAS1000 A LAM			EA	1.000
	4.....	201-100300	RES 100K 01% 1/8W PRES			EA	1.000
	4.....	201-124000	RES 124 01% 1/8W PRES			EA	2.000
	4.....	201-200100	RES 2K 01% 1/8W PRES			EA	1.000
	4.....	201-200300	RES 200K 01% 1/8W PRES			EA	1.000
	4.....	201-221100	RES 2.21K 01% 1/8W PRES			EA	1.000
	4.....	201-249000	RES 249 01% 1/8W PRES			EA	2.000
	4.....	201-249100	RES 2.49K 01% 1/8W PRES			EA	1.000
	4.....	201-301000	RES 301 01% 1/8W PRES			EA	1.000
	4.....	201-365000	RES 365 01% 1/8W PRES			EA	1.000
	4.....	201-499100	RES 4.99K 01% 1/8W PRES			EA	2.000
	4.....	201-604000	RES 604 01% 1/8W PRES			EA	1.000
	4.....	201-619200	RES 61.9K 01% 1/8W PRES			EA	1.000
	4.....	201-825000	RES 825 01% 1/8W PRES			EA	1.000
	3.....	465-001200	2090 REAR PANEL BAY 2			EA	1.000
	4.....	015-706300	PIN/350663-6 AMP SPOOL			EA	12.000
	4.....	015-706400	PIN/350665-2 AMP SPOOL			EA	12.000
	4.....	019-708700	XFORMER/DJ346			EA	1.000
	4.....	024-711500	CON/5F CIR/SOL SWC 61MA5F			EA	1.000
	4.....	024-711600	CON/5M CIR/SOL SWC 12CL5M			EA	1.000
	4.....	024-721400	CON/1F CXL/SOL APH 31-010			EA	2.000
	4.....	024-721600	CON/4F REC/CRP AMP 1-350240-9			EA	1.000
	4.....	024-723300	CON/2F REC/CRP AMP 1-350354-9			EA	1.000
	4.....	024-724600	CON/10F REC/IDP MMM 3473-6000			EA	1.000
	4.....	024-726900	CON/6F REC/CRP AMP 1-350241-9			EA	1.000
	4.....	024-730800	CONN/15 PIN 1-350237-9			EA	1.000
	4.....	025-727500	SW/CW/GF-642			EA	2.000
	4.....	068-726608	FAN/2090 REAR BAY 2	X		EA	1.000
	4.....	070-701100	FUSE/348890 BODY			EA	1.000
	4.....	070-701200	FUSE/348007 CAP			EA	1.000
	4.....	102-700200	MOVISTOR/V130LA10A			EA	2.000
	4.....	114-701800	FLTR/6 AMP 6H9 CORCOM			EA	1.000
	3.....	465-001300	2090 REAR PANEL BAY 1			EA	1.000
	4.....	415-005200	2090 CAP BD P.S. BAY 1			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002100			2090-3A/DIGITAL I/O				1
	5.....	000-900106	P.C.B./CAP BD/EXP SERIES	X		EA	1.000
	5.....	015-706300	PIN/350663-6 AMP SPOOL			EA	12.000
	5.....	015-706400	PIN/350665-2 AMP SPOOL			EA	12.000
	5.....	022-705300	DIO BRID VS647 600V 2A J VAR			EA	2.000
	5.....	023-716200	CAP 8800MF 25V ALUM S CAL			EA	2.000
	5.....	023-717500	CAP 28KMF 15V ALUM S MEP			EA	2.000
	5.....	023-719000	CAP 2000MF 50V ALUM S CAL			EA	2.000
	5.....	024-719900	CON/15F REC/CRP AMP 1-350244-9			EA	1.000
	5.....	024-721800	CON/12M REC/CRP AMP 1-350236-9			EA	1.000
	5.....	085-702400	CORD/428-=056 ROTRON			EA	1.000
	4.....	475-002500	MECH MISC/BAY 1 P.S.			EA	1.000
	5.....	022-713800	DIO RECT SCPE05 50V 5A Q SEM			EA	1.000
	5.....	068-726706	FAN/2090 REAR BAY 1	X		EA	1.000
	5.....	072-700100	FAN/WISPER WR2A1			EA	1.000
	5.....	114-702600	FLTR./FAN/PAMOTER#5502			EA	1.000
	2.....	645-000500	2090 BAY 3 POWER SUPPLY			EA	1.000
	3.....	415-005500	2090 POWER SUPPLY BD BAY 3			EA	1.000
	4.....	000-902103	P.C.B./2090 BAY 3 SUPPLY	X		EA	1.000
	4.....	006-701400	WASH/NO J TEFLON			EA	4.000
	4.....	011-721900	BRKT/THIRD BAY P.S./2090.3	X		EA	2.000
	4.....	015-706300	PIN/350663-6 AMP SPOOL			EA	6.000
	4.....	021-708800	TRN NPN 2N5301 40V 200W D MOT			EA	2.000
	4.....	022-700800	DIO RECT 1N4004 400V 1A G TXI			EA	6.000
	4.....	022-707100	DIO TRRM 3SM2 200V 2A G SEM			EA	4.000
	4.....	023-700200	CAP 1000PF 300V 5% MICA R ARC			EA	2.000
	4.....	023-704700	CAP 1MF 35V 10% TANT G KEM			EA	1.000
	4.....	023-711000	CAP 22MF 35V 10% TANT G KEM			EA	4.000
	4.....	023-714000	CAP 100MF 50V ALUM G SPG			EA	1.000
	4.....	023-716200	CAP 8800MF 25V ALUM S CAL			EA	2.000
	4.....	023-717500	CAP 28KMF 15V ALUM S MEP			EA	1.000
	4.....	024-719500	CON/9M HDR/SOL AMP 9-350262-1			EA	1.000
	4.....	024-726900	CON/6F REC/CRP AMP 1-350241-9			EA	1.000
	4.....	026-705400	POT/500 PCB DAL 784-20-501			EA	2.000
	4.....	032-700800	INSUL/DIODE			EA	2.000
	4.....	098-704700	HT SNK/THM6006B-2-2			EA	1.000
	4.....	106-701800	RES .18 10% 2W			EA	1.000
	4.....	106-702700	RES .36 05% 2W			EA	1.000
	4.....	108-022200	RES 2.2K 05% 1/4W			EA	2.000
	4.....	108-027100	RES 270 05% 1/4W			EA	2.000
	4.....	121-702400	REG -1.2TO-37V 1.5A 337T E NAT			EA	1.000
	4.....	121-702600	REG 2TO38V ,15A LAS1000 A LAM			EA	2.000
	4.....	201-124000	RES 124 01% 1/8W PRES			EA	1.000
	4.....	201-150000	RES 150 01% 1/8W PRES			EA	1.000
	4.....	201-200100	RES 2K 01% 1/8W PRES			EA	1.000
	4.....	201-301000	RES 301 01% 1/8W PRES			EA	2.000
	4.....	201-365000	RES 365 01% 1/8W PRES			EA	1.000
	4.....	201-[illegible]	[illegible]			[illegible]	[illegible]

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002100			2090-3A/DIGITAL I/O				1
	3.....	475-003100	MECH MISC/BAY 3 P.S.			EA	1.000
	4.....	002-706500	PLATE/I/O COVER	X		EA	1.000
	4.....	015-706300	PIN/350663-6 AMP SPOOL			EA	6.000
	4.....	015-706400	PIN/350665-2 AMP SPOOL			EA	6.000
	4.....	019-707700	XFORMER/DG-447 FOREST			EA	1.000
	4.....	024-719800	CON/9F REC/CRP AMP 1-350242-9			EA	1.000
	4.....	024-727000	CON/6M REC/CRP AMP 1-350234-9			EA	1.000
	4.....	068-728003	PAN/2090 REAR BAY 3	X		EA	1.000
	4.....	070-703000	FUSE/SLO BLO 3AG3			EA	2.000
	1.....	845-000700	DIGITAL I/O - A ADD			EA	1.000
	2.....	415-006800	I/O CONN CARD			EA	1.000
	3.....	000-902401	P.C.B./I/O CARD/2090-3	X		EA	1.000
	3.....	011-721000	BRKT/PWR SPLY MTG/2090	X		EA	1.000
	3.....	134-715303	IC/7438N O/C 2-NAND			EA	5.000
	2.....	415-007400	20% DIGITAL I/O BD			EA	1.000
	3.....	000-902205	PCB 2090 I/O	X		EA	1.000
	3.....	015-706400	PIN 350665-2 AMP SPOOL			EA	6.000
	3.....	023-700200	CAP 1000PF 300V 5% MICA R ARC			EA	1.000
	3.....	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	6.000
	3.....	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	8.000
	3.....	024-723400	CON/2M HDR/SOL AMP 9-350360-1			EA	1.000
	3.....	024-726900	CON/6F REC/CRP AMP 1-350241-9			EA	1.000
	3.....	024-733200	CON/6M HDR/SOL AMP 9-350259-2			EA	1.000
	3.....	024-734000	CONN/IC SOC/20 PIN			EA	2.000
	3.....	024-737200	CONN/56PIN/AMP 67907.3			EA	1.000
	3.....	085-707700	CBL/50 COND/7 IN./SPEC			EA	1.000
	3.....	100-700700	RES NET/CSP10E-01-502J			EA	2.000
	3.....	108-010300	RES 10K 05% 1/4W			EA	4.000
	3.....	108-033100	RES 330 05% 1/4W			EA	1.000
	3.....	134-712803	IC/74LS00N 2-NAND			EA	3.000
	3.....	134-712903	IC/74LS04N HEX INVERTER			EA	3.000
	3.....	134-713203	IC/74LS74N FLIP-FLOP			EA	4.000
	3.....	134-713703	IC/74LS253N MULTIPLEXER			EA	1.000
	3.....	134-715303	IC/7438N O/C 2-NAND			EA	2.000
	3.....	134-718803	IC/74LS175N REGISTER			EA	3.000
	3.....	134-720403	IC/74LS02N 2-NOR			EA	2.000
	3.....	134-720503	IC/74LS174N REGISTER			EA	5.000
	3.....	134-721203	IC/74LS163N COUNTER			EA	2.000
	3.....	134-722403	IC/74LS139N MULTIPLEXER			EA	1.000
	3.....	134-723003	IC/74LS14N HEX INVERTER			EA	4.000
	3.....	134-723903	IC/74LS257 MULTIPLEXER			EA	6.000
	3.....	134-728803	IC/74S472 PROM			EA	2.000
	3.....	134-730903	IC/74LS367N HEX DRIVER			EA	4.000
	3.....	134-731003	IC/74LS138N MULTIPLEXER			EA	2.000
	3.....	134-731903	IC/74LS395N SHIFT REGISTER			EA	4.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
							1
885-002200			2090-3B/DISK				
	1	845-000300	2090-3 MAIN FRAME			EA	1.000
	2	415-004900	2090 MAIN FRAME BD			EA	1.000
	3	000-900301	PCB/MAIN FRAME/EXP SERIES	X		EA	1.000
	3	021-702500	TRN NPN 2N3302 30V .36W A		MOT	EA	2.000
	3	022-701100	DIO GERM 1N270 80V .2A G		ITT	EA	5.000
	3	023-701600	CAP 2.2MF 20V 10% TANT G		KEM	EA	2.000
	3	023-702400	CAP .01MF 100V 20% CERM R		SPG	EA	2.000
	3	023-711100	CAP 4.7MF 10V 10% TANT G		KEM	EA	9.000
	3	023-711300	CAP .1MF 250V 10% PLYE R		SEC	EA	7.000
	3	024-715900	CON/16F DIP/SOL AMP 640358-3			EA	1.000
	3	024-721300	CON/24F DIP/SOL AMP 640361-3			EA	2.000
	3	024-724800	CON/40F DIP/SOL AMP 640379-3			EA	3.000
	3	024-734000	CONN/IC SOC/20 PIN			EA	5.000
	3	024-737200	CONN/56PIN/AMP 67907.3			EA	1.000
	3	026-705500	POT/1K PCB DAL 784-20-102			EA	2.000
	3	100-700700	RES NET/CSP10E-01-502J			EA	3.000
	3	108-010300	RES 10K 05% 1/4W			EA	1.000
	3	108-010400	RES 100K 05% 1/4W			EA	1.000
	3	108-039100	RES 390 05% 1/4W			EA	6.000
	3	108-047200	RES 4.7K 05% 1/4W			EA	11.000
	3	108-047300	RES 47K 05% 1/4W			EA	1.000
	3	121-700900	REG -15V .35A 79M15AUC E		FCH	EA	1.000
	3	134-705703	IC/741CF			EA	2.000
	3	134-712903	IC/74LS04N HEX INVERTER			EA	1.000
	3	134-713203	IC/74LS74N FLIP-FLOP			EA	6.000
	3	134-713703	IC/74LS253N MULTIPLEXER			EA	1.000
	3	134-717403	IC/74S287N PROM			EA	1.000
	3	134-718503	IC/74S182N CARRY LOOKAHEAD			EA	1.000
	3	134-720503	IC/74LS174N REGISTER			EA	4.000
	3	134-724500	IC/DAC80-CBI-V 12BIT DAC			EA	2.000
	3	134-724903	IC/74S169 COUNTER			EA	3.000
	3	134-728803	IC/74S472 PROM			EA	5.000
	3	134-730903	IC/74LS367N HEX DRIVER			EA	6.000
	3	134-731003	IC/74LS138N MULTIPLEXER			EA	3.000
	3	134-731603	IC/74LS251N MULTIPLEXER			EA	2.000
	3	134-732100	IC/96L02 MONOSTABLE			EA	1.000
	3	134-734300	IC/2901A 4BIT SLICE			EA	3.000
	2	415-005000	2090 BLANKING BD			EA	1.000
	3	000-900202	PCB/2090 BLANKING	X		EA	1.000
	3	015-706400	PIN/350665-2 AMP SPOOL			EA	12.000
	3	017-704200	LABEL/HI VOLT/EXPL	X		EA	1.000
	3	021-700600	TRN NPN 2N2484 60V .36W		A MOT	EA	4.000
	3	021-702200	TRN NPN 2N3903 40V 1W		B MOT	EA	1.000
	3	021-711100	TRN NPN MPSU10 300V 1W		E MOT	EA	4.000
	3	021-711400	TRN FETP M113 30V .22W		A SLX	EA	1.000
	3	022-700800	DIO RECT 1N4004 400V 1A		G TXI	EA	1.000
	3						
	3						

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002200			2090-3B/DISK				1
	3.....	023-707500	CAP 6.8MF 35V 10% TANT G KEM			EA	1.000
	3.....	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	1.000
	3.....	023-711300	CAP .1MF 250V 10% PLYE R SEC			EA	6.000
	3.....	023-719400	CAP .01MF 3000V 20% CERM R SPG			EA	2.000
	3.....	024-719900	CON/15F REC/CRP AMP 1-350244-9			EA	1.000
	3.....	024-724600	CON/10F REC/IDP MMM 3473-6000			EA	1.000
	3.....	024-734900	CON/8M HDR/SOL BRG 65532-108			EA	2.000
	3.....	024-735900	CONN/10PIN/3M3474.0001T			EA	1.000
	3.....	026-705700	POT/5K PCB DAL 784-20-502			EA	5.000
	3.....	026-705900	POT/500K PCB DAL 784-20-504			EA	1.000
	3.....	026-706400	POT/1MEG PCB DAL 784-20-105			EA	1.000
	3.....	032-700600	INSUL/TRANSIS PAD			EA	4.000
	3.....	042-711400	COVER/BLANK-2090	X		EA	1.000
	3.....	042-712600	COVER/BLANKING BD	X		EA	1.000
	3.....	105-022300	RES 22K 05% 2W			EA	2.000
	3.....	105-027300	RES 27K 05% 2W			EA	2.000
	3.....	108-010500	RES 1M 05% 1/4W			EA	1.000
	3.....	108-022200	RES 2.2K 05% 1/4W			EA	1.000
	3.....	108-022300	RES 22K 05% 1/4W			EA	2.000
	3.....	108-022400	RES 220K 05% 1/4W			EA	1.000
	3.....	108-047100	RES 470 05% 1/4W			EA	2.000
	3.....	108-047200	RES 4.7K 05% 1/4W			EA	1.000
	3.....	108-056000	RES 56 05% 1/4W			EA	1.000
	3.....	134-729400	IC/6N137			EA	1.000
	3.....	201-100300	RES 100K 01% 1/8W PRES			EA	2.000
	3.....	201-127300	RES 127K 01% 1/8W PRES			EA	3.000
	3.....	201-165200	RES 16.5K 01% 1/8W PRES			EA	1.000
	3.....	201-200200	RES 20K 01% 1/8W PRES			EA	3.000
	3.....	201-200300	RES 200K 01% 1/8W PRES			EA	4.000
	3.....	201-243200	RES 24.3K 01% 1/8W PRES			EA	1.000
	3.....	201-249100	RES 2.49K 01% 1/8W PRES			EA	1.000
	3.....	201-499200	RES 49.9K 01% 1/8W PRES			EA	1.000
	3.....	201-750200	RES 75K 01% 1/8W PRES			EA	1.000
	3.....	201-976200	RES 97.6K 01% 1/8W PRES			EA	1.000
	2.....	415-007000	2090 4K MEMORY BD			EA	1.000
	3.....	000-900402	P.C.B./2090 MEMORY 4K	X		EA	1.000
	3.....	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	1.000
	3.....	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	4.000
	3.....	024-734400	CON/18F DIP/SOL AMP 640359-3			EA	13.000
	3.....	024-737200	CONN/56PIN/AMP 67907.3			EA	1.000
	3.....	100-700700	RES NET/CSP10E-01-502J			EA	1.000
	3.....	108-047100	RES 470 05% 1/4W			EA	1.000
	3.....	134-723003	IC/74LS14N HEX INVERTER			EA	1.000
	3.....	134-723903	IC/74LS257 MULTIPLEXER			EA	4.000
	3.....	134-730903	IC/74LS367N HEX DRIVER			EA	3.000
	3.....	134-736803	IC/74LS374N REGISTER			EA	4.000
	3.....	134-736903	IC/74LS241N OCTAL BUFFER			EA	3.000
	3.....	134-742300	IC/2141-2			EA	13.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
825-002200			2090-3B/DISK				1
	2.....	415-007100	2090-3 INNER CONN BD 4K			EA	1.000
	3.....	000-900500	PCB/INTERFACE BD/2090	X		EA	1.000
	3.....	024-725000	CON/12M HDR/SOL AMP 9-350264-1			EA	1.000
	3.....	085-707900	CBL/50 COND/DAISY CHAIN			EA	1.000
	2.....	465-001400	2090 FRONT PANEL			EA	1.000
	3.....	011-723001	BRKT/2090 STRAIN RELIEF	X		EA	1.000
	3.....	015-706300	PIN/350663-6 AMP SPOOL			EA	4.000
	3.....	017-704600	LABEL/LOGO/JEWEL			EA	1.000
	3.....	022-714800	DIO LEDG FLV340 2.3V20MA L FCH			EA	1.000
	3.....	024-721700	CON/4M REC/CRP AMP 1-350233-9			EA	1.000
	3.....	025-715500	SW/PA166-011-0AA			EA	2.000
	3.....	025-718100	SW/7215J612ZCE-2 C&K			EA	2.000
	3.....	025-718500	SW/LB 2P2T LI 01-700155			EA	1.000
	3.....	025-721300	SW/TOGGLE #LFH-123			EA	2.000
	3.....	025-727100	SW/845773-SK-1			EA	1.000
	3.....	025-727200	SW/C & K SPDT 8121-J82			EA	1.000
	3.....	025-734300	SW/RO 1PL2-7PS CL PA166-025			EA	1.000
	3.....	045-703301	KNOB/KX-12322 1/8"			EA	4.000
	3.....	068-726905	FAN/2090 FRONT BAY 2	X		EA	1.000
	3.....	068-741001	FAN/2090 FRONT SUB BAY 2	X		EA	1.000
	3.....	085-900000	CBL/26 COND/2090 FRONT	X		EA	1.000
	3.....	093-702400	FASTNR/SCR 6-32 X 1/4" BLK			EA	4.000
	2.....	475-001500	2090-3 FINAL ASMB			EA	1.000
	3.....	011-724500	BRKT/FRAME GROUND/2090			EA	1.000
	3.....	017-704101	LABEL/2090-3	X		EA	1.000
	3.....	026-707800	POT/BA811-6670C.L. 250K			EA	1.000
	3.....	042-710903	COVER/BOTTOM/EXPL.III	X		EA	1.000
	3.....	042-712500	COVER/LINE VOLTAGE	X		EA	1.000
	3.....	042-712803	COVER/2090-3 L SIDE	X		EA	2.000
	3.....	051-700100	BUMPER/SJ5004X			EA	2.000
	3.....	051-700300	BUMPER/5025			EA	5.000
	3.....	085-703800	CORD/A/C/LINE P2392 SW			EA	1.000
	3.....	164-700500	GRAT/BLUE/EXPL.	X		EA	1.000
	3.....	268-703001	BEZEL/EXP SERIES	X		EA	1.000
	3.....	268-704300	MECH MISC/TILT STAND/14"			LA	1.000
	2.....	475-001700	2090-3 CAB ASMB			EA	1.000
	3.....	010-701500	NUT/SQUARE .860" #8-32	X		EA	1.000
	3.....	024-740300	CONN/AMP 87499-3/2PIN			EA	1.000
	3.....	027-700600	C.R.T./82D14GH/AMPEREX			EA	1.000
	3.....	034-714701	RAIL/TOP CENTER/EXPL.	X		EA	1.000
	3.....	034-714803	RAIL/SIDE EXPL			EA	2.000
	3.....	034-714901	RAIL/CONN/EXPL	X		EA	8.000
	3.....	034-715301	RAIL/CORNER SUPPORT	X		EA	1.000
	3.....	034-715401	RAIL/PLUG IN	X		EA	2.000
	3.....	044-704305	SHIELD/2090 CRT	X		EA	1.000
	3.....	049-700100	[illegible] INYLUXE			EA	1.000
	3.....	[illegible]	[illegible]			[illegible]	[illegible]

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002200			2090-3B/DISK				1
	2.....	645-000400	2090 M.F.POWER SUPPLY			EA	1.000
	3.....	415-005300	2090 POWER SUPPLY BD			EA	1.000
	4.....	000-900004	PCB/2090 REGULATOR	X		EA	1.000
	4.....	006-701400	WASH/NO J TEFLON			EA	2.000
	4.....	011-716401	BRKT/H.V. XFORMER 60HZ	X		EA	1.000
	4.....	011-720900	BRKT/INTEN. FOCUS/2090	X		EA	1.000
	4.....	011-721000	BRKT/PWR SPLY MTG/2090	X		EA	2.000
	4.....	011-723101	BRKT/HI VOLT XFORMER/EXPL	X		EA	1.000
	4.....	015-706400	PIN/350665-2 AMP SPOOL			EA	30.000
	4.....	017-704200	LABEL/HI VOLT/EXPL	X		EA	6.000
	4.....	019-706000	XFORMER/ITA-1552-11			EA	1.000
	4.....	019-707000	XFORMER/HV WINDING/EXPL2 3	X		EA	1.000
	4.....	021-703800	TRN NPN 2N5978 60V 75W E MOT			EA	2.000
	4.....	021-708800	TRN NPN 2N5301 40V 200W D MOT			EA	1.000
	4.....	022-700800	DIO RECT 1N4004 400V 1A G TXI			EA	6.000
	4.....	022-705100	DIO ZENR 1N5268 82V .5W G MOT			EA	1.000
	4.....	022-706900	DIO TRRF FM50 5KV .01A G SEM			EA	2.000
	4.....	022-707000	DIO TRRF S2F 200V 1A G SEM			EA	5.000
	4.....	022-711900	DIO BRID VE48X 400V 1A C VAR			EA	1.000
	4.....	023-029200	CAP 22MF 15V 10% TANT G KEM			EA	1.000
	4.....	023-700200	CAP 1000PF 300V 5% MICA R ARC			EA	1.000
	4.....	023-702800	CAP .68MF 35V 10% TANT G KEM			EA	1.000
	4.....	023-704700	CAP 1MF 35V 10% TANT G KEM			EA	2.000
	4.....	023-706900	CAP 50MF 50V ALUM G SPG			EA	1.000
	4.....	023-707300	CAP 1MF 200V 10% MYLR G TRW			EA	2.000
	4.....	023-711200	CAP 220MF 10V 10% TANT G KEM			EA	1.000
	4.....	023-713500	CAP 4.7MF 50V 10% TANT G KEM			EA	2.000
	4.....	023-719400	CAP .01MF 3000V 20% CERM R SPG			EA	5.000
	4.....	023-719700	CAP 2.2MF 50V 10% TANT G KEM			EA	5.000
	4.....	024-719600	CON/15M HDR/SOL AMP 9-350268-1			EA	1.000
	4.....	024-722500	CON/12F REC/CRP AMP 1-350243-9			EA	2.000
	4.....	024-723400	CON/2M HDR/SOL AMP 9-350360-1			EA	1.000
	4.....	024-726900	CON/6F REC/CRP AMP 1-350241-9			EA	1.000
	4.....	026-705400	POT/500 PCB DAL 784-20-501			EA	5.000
	4.....	026-706000	POT/20K PCB DAL 784-20-203			EA	1.000
	4.....	026-706500	POT/BRNS 500K			EA	2.000
	4.....	032-700800	INSUL/DIODE			EA	1.000
	4.....	032-700900	INSUL/DIODE			EA	7.000
	4.....	044-704600	SHIELD/H.V. EXPL.	X		EA	1.000
	4.....	067-700300	CORE/E1960-S-011A			EA	2.000
	4.....	070-703400	FUSE/.75 A/276.750 LITTLEFUSE			EA	1.000
	4.....	079-700000	THERMOS/165 DEG 7BTL6B10			EA	1.000
	4.....	098-700200	HT SNK/207CB W			EA	1.000
	4.....	098-704000	HT SNK/EXPL F.S.	X		EA	1.000
	4.....	098-704300	HT SNK	X		EA	1.000
	4.....	101-010500	RES 1M 10% 1/2W			EA	2.000
	4.....	101-022500	RES 2.2M 10% 1/2W			EA	2.000
	4.....	105-012100	RES 120 05% 2W			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002200			2090-3B/DISK				1
	4.....	106-703500	RES .1 05% 10W			EA	1.000
	4.....	106-703600	RES 200M 10% 1W			EA	1.000
	4.....	108-010300	RES 10K 05% 1/4W			EA	1.000
	4.....	108-015300	RES 15K 05% 1/4W			EA	1.000
	4.....	108-022100	RES 220 05% 1/4W			EA	2.000
	4.....	108-027100	RES 270 05% 1/4W			EA	1.000
	4.....	108-033200	RES 3.3K 05% 1/4W			EA	1.000
	4.....	121-702100	REG 5 TO 30V 1A 78GU1C E FCH			EA	1.000
	4.....	121-702300	REG 1.2 TO 37V 1.5A 317T E NAT			EA	2.000
	4.....	121-702400	REG -1.2TO-37V 1.5A 337T E NAT			EA	2.000
	4.....	121-702600	REG 2TO38V .15A LAS1000 A LAM			EA	1.000
	4.....	201-100300	RES 100K 01% 1/8W PRES			EA	1.000
	4.....	201-124000	RES 124 01% 1/8W PRES			EA	2.000
	4.....	201-200100	RES 2K 01% 1/8W PRES			EA	1.000
	4.....	201-200300	RES 200K 01% 1/8W PRES			EA	1.000
	4.....	201-221100	RES 2.21K 01% 1/8W PRES			EA	1.000
	4.....	201-249000	RES 249 01% 1/8W PRES			EA	2.000
	4.....	201-249100	RES 2.49K 01% 1/8W PRES			EA	1.000
	4.....	201-301000	RES 301 01% 1/8W PRES			EA	1.000
	4.....	201-365000	RES 365 01% 1/8W PRES			EA	1.000
	4.....	201-499100	RES 4.99K 01% 1/8W PRES			EA	2.000
	4.....	201-604000	RES 604 01% 1/8W PRES			EA	1.000
	4.....	201-619200	RES 61.9K 01% 1/8W PRES			EA	1.000
	4.....	201-825000	RES 825 01% 1/8W PRES			EA	1.000
	3.....	465-001200	2090 REAR PANEL BAY 2			EA	1.000
	4.....	015-706300	PIN/350663-6 AMP SPOOL			EA	12.000
	4.....	015-706400	PIN/350665-2 AMP SPOOL			EA	12.000
	4.....	019-708700	XFORMER/DJ346			EA	1.000
	4.....	024-711500	CON/5F CIR/SOL SWC 61HA5F			EA	1.000
	4.....	024-711600	CON/5M CIR/SOL SWC 12CL5M			EA	1.000
	4.....	024-721400	CON/1F CXL/SOL APH 31-010			EA	2.000
	4.....	024-721600	CON/4F REC/CRP AMP 1-350240-9			EA	1.000
	4.....	024-723300	CON/2F REC/CRP AMP 1-350354-9			EA	1.000
	4.....	024-724600	CON/10F REC/IDP MMM 3473-6000			EA	1.000
	4.....	024-726900	CON/6F REC/CRP AMP 1-350241-9			EA	1.000
	4.....	024-730800	CONN/15 PIN 1-350237-9			EA	1.000
	4.....	025-727500	SW/CW/GF-642			EA	2.000
	4.....	068-726608	PAN/2090 REAR BAY 2	X		EA	1.000
	4.....	070-701100	FUSE/348890 BODY			EA	1.000
	4.....	070-701200	FUSE/348007 CAP			EA	1.000
	4.....	102-700200	MOVISTOR/V130LA10A			EA	2.000
	4.....	114-701800	FLTR/6 AMP 6H9 CORCOM			EA	1.000
	3.....	465-001300	2090 REAR PANEL BAY 1			EA	1.000
	4.....	415-005200	2090 CAP BD P.S. BAY 1			EA	1.000
	5.....	000-900106	P.C.B./CAP BD/EXP SERIES	X		EA	1.000
	5.....	015-706300	PIN/350663-6 AMP SPOOL			EA	12.000
	5.....	015-706400					

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002200			2090-3B/DISK				1
	5.....	023-716200	CAP 8800MF 25V ALUM S CAL			EA	2.000
	5.....	023-717500	CAP 28KMF 15V ALUM S MEP			EA	2.000
	5.....	023-719000	CAP 2000MF 50V ALUM S CAL			EA	2.000
	5.....	024-719900	CON/15F REC/CRP AMP 1-350244-9			EA	1.000
	5.....	024-721800	CON/12M REC/CRP AMP 1-350236-9			EA	1.000
	5.....	085-702400	CORD/428-=056 ROTRON			EA	1.000
	4.....	475-002500	MECH MISC/BAY 1 P.S.			EA	1.000
	5.....	022-713800	DIO RECT SCPE05 50V 5A Q SEM			EA	1.000
	5.....	068-726706	PAN/2090 REAR BAY 1	X		EA	1.000
	5.....	072-700100	FAN/WISPER WR2A1			EA	1.000
	5.....	114-702600	FLTR./FAN/FAMOTER#5502			EA	1.000
	2.....	645-000500	2090 BAY 3 POWER SUPPLY			EA	1.000
	3.....	415-005500	2090 POWER SUPPLY BD BAY 3			EA	1.000
	4.....	000-902103	P.C.B./2090 BAY 3 SUPPLY	X		EA	1.000
	4.....	006-701400	WASH/NO J TEFLON			EA	4.000
	4.....	011-721900	BRKT/THIRD BAY P.S./2090.3	X		EA	2.000
	4.....	015-706300	PIN/350663-6 AMP SPOOL			EA	6.000
	4.....	021-708800	TRN NPN 2N5301 40V 200W D MOT			EA	2.000
	4.....	022-700800	DIO RECT 1N4004 400V 1A G TXI			EA	6.000
	4.....	022-707100	DIO TRRM 3SM2 200V 2A G SEM			EA	4.000
	4.....	023-700200	CAP 1000PF 300V 5% MICA R ARC			EA	2.000
	4.....	023-704700	CAP 1MF 35V 10% TANT G KEM			EA	1.000
	4.....	023-711000	CAP 22MF 35V 10% TANT G KEM			EA	4.000
	4.....	023-714000	CAP 100MF 50V ALUM G SPG			EA	1.000
	4.....	023-716200	CAP 8800MF 25V ALUM S CAL			EA	2.000
	4.....	023-717500	CAP 28KMF 15V ALUM S MEP			EA	1.000
	4.....	024-719500	CON/9M HDR/SOL AMP 9-350262-1			EA	1.000
	4.....	024-726900	CON/6F REC/CRP AMP 1-350241-9			EA	1.000
	4.....	026-705400	POT/500 PCB DAL 784-20-501			EA	2.000
	4.....	032-700800	INSUL/DIODE			EA	2.000
	4.....	098-704700	HT SNK/THM6006B-2-2			EA	1.000
	4.....	106-701800	RES .18 10% 2W			EA	1.000
	4.....	106-702700	RES .36 05% 2W			EA	1.000
	4.....	108-022200	RES 2.2K 05% 1/4W			EA	2.000
	4.....	108-027100	RES 270 05% 1/4W			EA	2.000
	4.....	121-702400	REG -1.2TO-37V 1.5A 337T E NAT			EA	1.000
	4.....	121-702600	REG 2TO38V .15A LAS1000 A LAM			EA	2.000
	4.....	201-124000	RES 124 01% 1/8W PRES			EA	1.000
	4.....	201-150000	RES 150 01% 1/8W PRES			EA	1.000
	4.....	201-200100	RES 2K 01% 1/8W PRES			EA	1.000
	4.....	201-301000	RES 301 01% 1/8W PRES			EA	2.000
	4.....	201-365000	RES 365 01% 1/8W PRES			EA	1.000
	4.....	201-604000	RES 604 01% 1/8W PRES			EA	2.000
	4.....	201-681900	RES 68.1 01% 1/8W PRES			EA	1.000
	3.....	475-003100	MECH MISC/BAY 3 P.S.			EA	1.000
	4.....	002-706500	PLATE/I/O COVER	X		EA	1.000
	4.....	015-706300	PIN/350663-6 AMP SPOOL			EA	6.000
	4.....	015-706400	PIN/350665-2 AMP SPOOL			EA	6.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002200			2090-3B/DISK				1
	4.....	019-707700	XFORMER/DG-447 FOREST			EA	1.000
	4.....	024-719800	CON/9F REC/CRP AMP 1-350242-9			EA	1.000
	4.....	024-727000	CON/6M REC/CRP AMP 1-350234-9			EA	1.000
	4.....	068-728003	FAN/2090 REAR BAY 3	X		EA	1.000
	4.....	070-703000	FUSE/SLO BLO 3AG3			EA	2.000
	1.....	845-000400	DISK-B ADD			EA	1.000
	2.....	415-005700	2090 DISK BD			EA	1.000
	3.....	000-901903	PCB/2090	X		EA	1.000
	3.....	015-701500	PIN/SOC 61173-1			EA	4.000
	3.....	019-707800	INDUCT/NYTRONICS/WEE 0.47UH			EA	1.000
	3.....	022-709400	DIO TRRF 1N4150 50V .2A G TXI			EA	1.000
	3.....	023-029200	CAP 22MF 15V 10% TANT G KEM			EA	3.000
	3.....	023-700300	CAP 500PF 500V 5% MICA R ARC			EA	3.000
	3.....	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	1.000
	3.....	023-710600	CAP 10PF 1000V 10% CERM R CLB			EA	1.000
	3.....	023-715100	CAP .05MF 50V CERM R ARC			EA	6.000
	3.....	024-703600	CON/4F REC/CRP AMP 1-480424-0			EA	1.000
	3.....	024-715900	CON/16F DIP/SOL AMP 640358-3			EA	4.000
	3.....	024-733200	CON/6M HDR/SOL AMP 9-350259-2			EA	1.000
	3.....	024-734000	CONN/IC SOC/20 PIN			EA	3.000
	3.....	024-734400	CON/18F DIP/SOL AMP 640359-3			EA	4.000
	3.....	024-745000	CON/64F DIP/SOL BDY DILBQ64P			EA	1.000
	3.....	025-718000	SW/C + K #8531			EA	1.000
	3.....	026-705700	POT/5K PCB DAL 784-20-502			EA	1.000
	3.....	085-709100	CBL/34 COND/AP 922523-34-99-12			EA	1.000
	3.....	100-700700	RES NET/CSP10E-01-502J			EA	2.000
	3.....	108-010000	RES 10 05% 1/4W			EA	4.000
	3.....	108-010100	RES 100 05% 1/4W			EA	1.000
	3.....	108-010200	RES 1K 05% 1/4W			EA	3.000
	3.....	108-010300	RES 10K 05% 1/4W			EA	5.000
	3.....	108-012300	RES 12K 05% 1/4W			EA	1.000
	3.....	108-015100	RES 150 05% 1/4W			EA	2.000
	3.....	108-027100	RES 270 05% 1/4W			EA	1.000
	3.....	108-033100	RES 330 05% 1/4W			EA	7.000
	3.....	108-047200	RES 4.7K 05% 1/4W			EA	2.000
	3.....	134-705303	IC/7404N HEX INVERTER			EA	1.000
	3.....	134-712803	IC/74LS00N 2-NAND			EA	4.000
	3.....	134-712903	IC/74LS04N HEX INVERTER			EA	1.000
	3.....	134-713203	IC/74LS74N FLIP-FLOP			EA	8.000
	3.....	134-716903	IC/74148N PRIORITY ENCODER			EA	1.000
	3.....	134-717503	IC/74S138N DEMULTIPLEXER			EA	1.000
	3.....	134-718103	IC/74LS191N COUNTER			EA	1.000
	3.....	134-720403	IC/74LS02N 2-NOR			EA	3.000
	3.....	134-720503	IC/74LS174N REGISTER			EA	2.000
	3.....	134-720803	IC/74LS10N 3-NAND			EA	1.000
	3.....	134-722005	IC/4040B CMOS 12 STAGE BIN COU			EA	1.000
		134-722403	IC/74LS139N MULTIPLEXER				1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002200			2090-3B/DISK				1
	3.....	134-728803	IC/74S472 PROM			EA	2.000
	3.....	134-730903	IC/74LS367N HEX DRIVER			EA	4.000
	3.....	134-731300	IC/9900JL PROCESSOR			EA	1.000
	3.....	134-731403	IC/74LS362N CLOCK DRIVER			EA	1.000
	3.....	134-731503	IC/74LS259N ADDRESSABLE LATCH			EA	3.000
	3.....	134-731603	IC/74LS251N MULTIPLEXER			EA	4.000
	3.....	134-731700	IC/2111A-4N 256 X 4 STATIC RAM			EA	4.000
	3.....	134-731803	IC/74LS155N DEMULTIPLEXER			EA	1.000
	3.....	134-731903	IC/74LS395N SHIFT REGISTER			EA	4.000
	3.....	134-732003	IC/74LS92N COUNTER			EA	1.000
	3.....	134-732100	IC/96L02 MONOSTABLE			EA	1.000
	3.....	191-705400	CRYSTAL/48MHZ/.05%			EA	1.000
	3.....	201-200200	RES 20K 01% 1/8W PRES			EA	1.000
	3.....	201-250200	RES 25K 01% 1/8W PRES			EA	1.000
	2.....	465-001500	2090 DISK FRONT PANEL			EA	1.000
	3.....	000-902001	P.C.B./LED BD/MINI DISK/EXP	X		EA	1.000
	3.....	011-722403	BRKT/DISK/EXP	X		EA	1.000
	3.....	022-707900	DIO LEDR FLV110 1.7V 20MAL FCH			EA	4.000
	3.....	022-714800	DIO LEDG FLV340 2.3V20MA L FCH			EA	8.000
	3.....	025-715500	SW/PA166-011-0AA			EA	1.000
	3.....	025-718100	SW/7215J612ZCE-2 C&K			EA	2.000
	3.....	025-719600	SW/7101J60 C+K			EA	9.000
	3.....	045-703301	KNOB/KX-12322 1/8"			EA	1.000
	3.....	068-727806	PAN/2090 DISK FRONT	X		EA	1.000
	3.....	068-740901	PAN/2090 DISK FRONT SUB	X		EA	1.000
	3.....	085-709000	CBL/34 COND/AP 922522-34-99-06			EA	1.000
	2.....	475-001800	2090 DISK MECH ASSY			EA	1.000
	3.....	020-702700	CHAS/2090 DISK SLIDE			EA	1.000
	3.....	034-715500	GUIDE/SCANBE 11633-1			EA	4.000
	3.....	222-009000	DISK DRIVE/SHUGART #SA400			EA	1.000
	3.....	270-700800	DISK/DYSAN 140/1			EA	2.000
	1.....	845-000500	2090-3B I/O			EA	1.000
	2.....	415-009000	2090 DISK W/O I/O BD			EA	1.000
	3.....	000-902702	PCB/2090 DISK W/O I/O	X		EA	1.000
	3.....	015-706400	PIN/350665-2 AMP SPOOL			EA	6.000
	3.....	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	3.000
	3.....	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	1.000
	3.....	023-715100	CAP .05MF 50V CERM R ARC			EA	2.000
	3.....	024-726900	CON/6F REC/CRP AMP 1-350241-9			EA	1.000
	3.....	024-727000	CON/6M REC/CRP AMP 1-350234-9			EA	1.000
	3.....	024-745000	CON/64F DIP/SOL BDY DILBQ64P			EA	1.000
	3.....	085-707800	CBL/50 COND/13 IN./SPEC			EA	1.000
	3.....	100-700700	RES NET/CSP10E-01-502J			EA	1.000
	3.....	108-010100	RES 100 05% 1/4W			EA	3.000
	3.....	134-712803	IC/74LS00N 2-NAND			EA	1.000
	3.....	134-713203	IC/74LS74N FLIP-FLOP			EA	1.000
	3.....	134-730903	IC/74LS367N HEX DRIVER			EA	6.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002300			2090-3C/DISK & DIGITAL I/O				1
	1.....	845-000300	2090-3 MAIN FRAME			EA	1.000
	2.....	415-004900	2090 MAIN FRAME BD			EA	1.000
	3.....	000-900301	PCB/MAIN FRAME/EXP SERIES	X		EA	1.000
	3.....	021-702500	TRN NPN 2N3302 30V .36W A MOT			EA	2.000
	3.....	022-701100	DIO GERM 1N270 80V .2A G ITT			EA	5.000
	3.....	023-701600	CAP 2.2MF 20V 10% TANT G KEM			EA	2.000
	3.....	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	2.000
	3.....	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	9.000
	3.....	023-711300	CAP .1MF 250V 10% PLYE R SEC			EA	7.000
	3.....	024-715900	CON/16F DIP/SOL AMP 640358-3			EA	1.000
	3.....	024-721300	CON/24F DIP/SOL AMP 640361-3			EA	2.000
	3.....	024-724800	CON/40F DIP/SOL AMP 640379-3			EA	3.000
	3.....	024-734000	CONN/IC SOC/20 PIN			EA	5.000
	3.....	024-737200	CONN/56PIN/AMP 67907.3			EA	1.000
	3.....	026-705500	POT/1K PCB DAL 784-20-102			EA	2.000
	3.....	100-700700	RES NET/CSP10E-01-502J			EA	3.000
	3.....	108-010300	RES 10K 05% 1/4W			EA	1.000
	3.....	108-010400	RES 100K 05% 1/4W			EA	1.000
	3.....	108-039100	RES 390 05% 1/4W			EA	6.000
	3.....	108-047200	RES 4.7K 05% 1/4W			EA	11.000
	3.....	108-047300	RES 47K 05% 1/4W			EA	1.000
	3.....	121-700900	REG -15V .35A 79M15AUC E FCH			EA	1.000
	3.....	134-705703	IC/741CP			EA	2.000
	3.....	134-712903	IC/74LS04N HEX INVERTER			EA	1.000
	3.....	134-713203	IC/74LS74N FLIP-FLOP			EA	6.000
	3.....	134-713703	IC/74LS253N MULTIPLEXER			EA	1.000
	3.....	134-717403	IC/74S287N PROM			EA	1.000
	3.....	134-718503	IC/74S182N CARRY LOOKAHEAD			EA	1.000
	3.....	134-720503	IC/74LS174N REGISTER			EA	4.000
	3.....	134-724500	IC/DAC80-CBI-V 12BIT DAC			EA	2.000
	3.....	134-724903	IC/74S169 COUNTER			EA	3.000
	3.....	134-728803	IC/74S472 PROM			EA	5.000
	3.....	134-730903	IC/74LS367N HEX DRIVER			EA	6.000
	3.....	134-731003	IC/74LS138N MULTIPLEXER			EA	3.000
	3.....	134-731603	IC/74LS251N MULTIPLEXER			EA	2.000
	3.....	134-732100	IC/96L02 MONOSTABLE			EA	1.000
	3.....	134-734300	IC/2901A 4BIT SLICE			EA	3.000
	2.....	415-005000	2090 BLANKING BD			EA	1.000
	3.....	000-900202	PCB/2090 BLANKING	X		EA	1.000
	3.....	015-706400	PIN/350665-2 AMP SPOOL			EA	12.000
	3.....	017-704200	LABEL/HI VOLT/EXPL	X		EA	1.000
	3.....	021-700600	TRN NPN 2N2484 60V .36W A MOT			EA	4.000
	3.....	021-702200	TRN NPN 2N3903 40V 1W B MOT			EA	1.000
	3.....	021-711100	TRN NPN MPSU10 300V 1W E MOT			EA	4.000
	3.....	021-711400	TRN FETP M113 30V .22W A SLX			EA	1.000
	3.....	022-700800	DIO RECT 1N4004 400V 1A G TXI			EA	1.000
	3.....	[illegible]	[illegible]			[illegible]	[illegible]

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002300			2090-3C/DISK & DIGITAL I/O				1
	3	023-707500	CAP 6.8MF 35V 10% TANT G KEM			EA	1.000
	3	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	1.000
	3	023-711300	CAP .1MF 250V 10% PLYE R SEC			EA	6.000
	3	023-719400	CAP .01MF 3000V 20% CERM R SPG			EA	2.000
	3	024-719900	CON/15F REC/CRP AMP 1-350244-9			EA	1.000
	3	024-724600	CON/10F REC/IDP MMM 3473-6000			EA	1.000
	3	024-734900	CON/8M HDR/SOL BRG 65532-108			EA	2.000
	3	024-735900	CONN/10PIN/3M3474.0001T			EA	1.000
	3	026-705700	POT/5K PCB DAL 784-20-502			EA	5.000
	3	026-705900	POT/500K PCB DAL 784-20-504			EA	1.000
	3	026-706400	POT/1MEG PCB DAL 784-20-105			EA	1.000
	3	032-700600	INSUL/TRANSIS PAD			EA	4.000
	3	042-711400	COVER/BLANK-2090	X		EA	1.000
	3	042-712600	COVER/BLANKING BD	X		EA	1.000
	3	105-022300	RES 22K 05% 2W			EA	2.000
	3	105-027300	RES 27K 05% 2W			EA	2.000
	3	108-010500	RES 1M 05% 1/4W			EA	1.000
	3	108-022200	RES 2.2K 05% 1/4W			EA	1.000
	3	108-022300	RES 22K 05% 1/4W			EA	2.000
	3	108-022400	RES 220K 05% 1/4W			EA	1.000
	3	108-047100	RES 470 05% 1/4W			EA	2.000
	3	108-047200	RES 4.7K 05% 1/4W			EA	1.000
	3	108-056000	RES 56 05% 1/4W			EA	1.000
	3	134-729400	IC/6N137			EA	1.000
	3	201-100300	RES 100K 01% 1/8W PRES			EA	2.000
	3	201-127300	RES 127K 01% 1/8W PRES			EA	3.000
	3	201-165200	RES 16.5K 01% 1/8W PRES			EA	1.000
	3	201-200200	RES 20K 01% 1/8W PRES			EA	3.000
	3	201-200300	RES 200K 01% 1/8W PRES			EA	4.000
	3	201-243200	RES 24.3K 01% 1/8W PRES			EA	1.000
	3	201-249100	RES 2.49K 01% 1/8W PRES			EA	1.000
	3	201-499200	RES 49.9K 01% 1/8W PRES			EA	1.000
	3	201-750200	RES 75K 01% 1/8W PRES			EA	1.000
	3	201-976200	RES 97.6K 01% 1/8W PRES			EA	1.000
	2	415-007000	2090 4K MEMORY BD			EA	1.000
	3	000-900402	P.C.B./2090 MEMORY 4K	X		EA	1.000
	3	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	1.000
	3	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	4.000
	3	024-734400	CON/18F DIP/SOL AMP 640359-3			EA	13.000
	3	024-737200	CONN/56PIN/AMP 67907.3			EA	1.000
	3	100-700700	RES NET/CSP10E-01-502J			EA	1.000
	3	108-047100	RES 470 05% 1/4W			EA	1.000
	3	134-723003	IC/74LS14N HEX INVERTER			EA	1.000
	3	134-723903	IC/74LS257 MULTIPLEXER			EA	4.000
	3	134-730903	IC/74LS367N HEX DRIVER			EA	3.000
	3	134-736803	IC/74LS374N REGISTER			EA	4.000
	3	134-736903	IC/74LS241N OCTAL BUFFER			EA	3.000
	3	134-742300	IC/2141-2			EA	13.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002300			2090-3C/DISK & DIGITAL I/O				1
	2.....	415-007100	2090-3 INNER CONN BD 4K			EA	1.000
	3.....	000-900500	PCB/INTERFACE BD/2090	X		EA	1.000
	3.....	024-725000	CON/12M HDR/SOL AMP 9-350264-1			EA	1.000
	3.....	085-707900	CBL/50 COND/DAISY CHAIN			EA	1.000
	2.....	465-001400	2090 FRONT PANEL			EA	1.000
	3.....	011-723001	BRKT/2090 STRAIN RELIEF	X		EA	1.000
	3.....	015-706300	PIN/350663-6 AMP SPOOL			EA	4.000
	3.....	017-704600	LABEL/LOGO/JEWEL			EA	1.000
	3.....	022-714800	DIO LEDG FLV340 2.3V20MA L FCH			EA	1.000
	3.....	024-721700	CON/4M REC/CRP AMP 1-350233-9			EA	1.000
	3.....	025-715500	SW/PA166-011-0AA			EA	2.000
	3.....	025-718100	SW/7215J612ZCE-2 C&K			EA	2.000
	3.....	025-718500	SW/LB 2P2T LI 01-700155			EA	1.000
	3.....	025-721300	SW/TOGGLE #LFH-123			EA	2.000
	3.....	025-727100	SW/845773-SK-1			EA	1.000
	3.....	025-727200	SW/C & K SPDT 8121-J82			EA	1.000
	3.....	025-734300	SW/RO 1PL2-7PS CL PA166-025			EA	1.000
	3.....	045-703301	KNOB/KX-12322 1/8"			EA	4.000
	3.....	068-726905	PAN/2090 FRONT BAY 2	X		EA	1.000
	3.....	068-741001	PAN/2090 FRONT SUB BAY 2	X		EA	1.000
	3.....	085-900000	CBL/26 COND/2090 FRONT	X		EA	1.000
	3.....	093-702400	FASTNR/SCR 6-32 X 1/4" BLK			EA	4.000
	2.....	475-001500	2090-3 FINAL ASMB			EA	1.000
	3.....	011-724500	BRKT/FRAME GROUND/2090			EA	1.000
	3.....	017-704101	LABEL/2090-3	X		EA	1.000
	3.....	026-707800	POT/BA811-6670C.L. 250K			EA	1.000
	3.....	042-710903	COVER/BOTTOM/EXPL.III	X		EA	1.000
	3.....	042-712500	COVER/LINE VOLTAGE	X		EA	1.000
	3.....	042-712803	COVER/2090-3 L SIDE	X		EA	2.000
	3.....	051-700100	BUMPER/SJ5004X			EA	2.000
	3.....	051-700300	BUMPER/5025			EA	5.000
	3.....	085-703800	CORD/A/C/LINE P2392 SW			EA	1.000
	3.....	164-700500	GRAT/BLUE/EXPL.	X		EA	1.000
	3.....	268-703001	BEZEL/EXP SERIES	X		EA	1.000
	3.....	268-704300	MECH MISC/TILT STAND/14"			EA	1.000
	2.....	475-001700	2090-3 CAB ASMB			EA	1.000
	3.....	010-701500	NUT/SQUARE .860" #8-32	X		EA	1.000
	3.....	024-740300	CONN/AMP 87499-3/2PIN			EA	1.000
	3.....	027-700600	C.R.T./82D14GH/AMPEREX			EA	1.000
	3.....	034-714701	RAIL/TOP CENTER/EXPL.	X		EA	1.000
	3.....	034-714803	RAIL/SIDE EXPL			EA	2.000
	3.....	034-714901	RAIL/CONN/EXPL	X		EA	8.000
	3.....	034-715301	RAIL/CORNER SUPPORT	X		EA	1.000
	3.....	034-715401	RAIL/PLUG IN	X		EA	2.000
	3.....	044-704305	SHIELD/2090 CRT	X		EA	1.000
	3.....	[illegible]	HANDLE/VINYLUXE			EA	1.000
	3.....	[illegible]	[illegible]			EA	[illegible]
	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002300			2090-3C/DISK & DIGITAL I/O				1
	2.....	645-000400	2090 M.F.POWER SUPPLY			EA	1.000
	3.....	415-005300	2090 POWER SUPPLY BD			EA	1.000
	4.....	000-900004	PCB/2090 REGULATOR	X		EA	1.000
	4.....	006-701400	WASH/NO J TEFLON			EA	2.000
	4.....	011-716401	BRKT/H.V. XFORMER 60HZ	X		EA	1.000
	4.....	011-720900	BRKT/INTEN. FOCUS/2090	X		EA	1.000
	4.....	011-721000	BRKT/PWR SPLY MTG/2090	X		EA	2.000
	4.....	011-723101	BRKT/HI VOLT XFORMER/EXPL	X		EA	1.000
	4.....	015-706400	PIN/350665-2 AMP SPOOL			EA	30.000
	4.....	017-704200	LABEL/HI VOLT/EXPL	X		EA	6.000
	4.....	019-706000	XFORMER/ITA-1552-11			EA	1.000
	4.....	019-707000	XFORMER/HV WINDING/EXPL2 3	X		EA	1.000
	4.....	021-703800	TRN NPN 2N5978 60V 75W E		MOT	EA	2.000
	4.....	021-708800	TRN NPN 2N5301 40V 200W D		MOT	EA	1.000
	4.....	022-700800	DIO RECT 1N4004 400V 1A G		TXI	EA	6.000
	4.....	022-705100	DIO ZENR 1N5268 82V .5W G		MOT	EA	1.000
	4.....	022-706900	DIO TRRF FM50 5KV .01A G		SEM	EA	2.000
	4.....	022-707000	DIO TRRF S2F 200V 1A G		SEM	EA	5.000
	4.....	022-711900	DIO BRID VE48X 400V 1A C		VAR	EA	1.000
	4.....	023-029200	CAP 22MF 15V 10% TANT G		KEM	EA	1.000
	4.....	023-700200	CAP 1000PF 300V 5% MICA R		ARC	EA	1.000
	4.....	023-702800	CAP .68MF 35V 10% TANT G		KEM	EA	1.000
	4.....	023-704700	CAP 1MF 35V 10% TANT G		KEM	EA	2.000
	4.....	023-706900	CAP 50MF 50V ALUM G		SPG	EA	1.000
	4.....	023-707300	CAP 1MF 200V 10% MYLR G		TRW	EA	2.000
	4.....	023-711200	CAP 220MF 10V 10% TANT G		KEM	EA	1.000
	4.....	023-713500	CAP 4.7MF 50V 10% TANT G		KEM	EA	2.000
	4.....	023-719400	CAP .01MF 3000V 20% CERM R		SPG	EA	5.000
	4.....	023-719700	CAP 2.2MF 50V 10% TANT G		KEM	EA	5.000
	4.....	024-719600	CON/15M HDR/SOL AMP 9-350268-1			EA	1.000
	4.....	024-722500	CON/12F REC/CRP AMP 1-350243-9			EA	2.000
	4.....	024-723400	CON/2M HDR/SOL AMP 9-350360-1			EA	1.000
	4.....	024-726900	CON/6F REC/CRP AMP 1-350241-9			EA	1.000
	4.....	026-705400	POT/500 PCB DAL 784-20-501			EA	5.000
	4.....	026-706000	POT/20K PCB DAL 784-20-203			EA	1.000
	4.....	026-706500	POT/BRNS 500K			EA	2.000
	4.....	032-700800	INSUL/DIODE			EA	1.000
	4.....	032-700900	INSUL/DIODE			EA	7.000
	4.....	044-704600	SHIELD/H.V. EXPL.	X		EA	1.000
	4.....	067-700300	CORE/E1960-S-011A			EA	2.000
	4.....	070-703400	FUSE/.75 A/276.750 LITTLEFUSE			EA	1.000
	4.....	079-700000	THERMOS/165 DEG 7BTL6B10			EA	1.000
	4.....	098-700200	HT SNK/207CB W			EA	1.000
	4.....	098-704000	HT SNK/EXPL P.S.	X		EA	1.000
	4.....	098-704300	HT SNK	X		EA	1.000
	4.....	101-010500	RES 1M 10% 1/2W			EA	2.000
	4.....	101-022500	RES 2.2M 10% 1/2W			EA	2.000
	4.....	105-012100	RES 120 05% 2W			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002300			2090-3C/DISK & DIGITAL I/O				1
	4.....	106-703500	RES .1 05% 10W			EA	1.000
	4.....	106-703600	RES 200M 10% 1W			EA	1.000
	4.....	108-010300	RES 10K 05% 1/4W			EA	1.000
	4.....	108-015300	RES 15K 05% 1/4W			EA	1.000
	4.....	108-022100	RES 220 05% 1/4W			EA	2.000
	4.....	108-027100	RES 270 05% 1/4W			EA	1.000
	4.....	108-033200	RES 3.3K 05% 1/4W			EA	1.000
	4.....	121-702100	REG 5 TO 30V 1A 78GU1C E FCH			EA	1.000
	4.....	121-702300	REG 1.2 TO 37V 1.5A 317T E NAT			EA	2.000
	4.....	121-702400	REG -1.2TO-37V 1.5A 337T E NAT			EA	2.000
	4.....	121-702600	REG 2TO38V ,15A LAS1000 A LAM			EA	1.000
	4.....	201-100300	RES 100K 01% 1/8W PRES			EA	1.000
	4.....	201-124000	RES 124 01% 1/8W PRES			EA	2.000
	4.....	201-200100	RES 2K 01% 1/8W PRES			EA	1.000
	4.....	201-200300	RES 200K 01% 1/8W PRES			EA	1.000
	4.....	201-221100	RES 2.21K 01% 1/8W PRES			EA	1.000
	4.....	201-249000	RES 249 01% 1/8W PRES			EA	2.000
	4.....	201-249100	RES 2.49K 01% 1/8W PRES			EA	1.000
	4.....	201-301000	RES 301 01% 1/8W PRES			EA	1.000
	4.....	201-365000	RES 365 01% 1/8W PRES			EA	1.000
	4.....	201-499100	RES 4.99K 01% 1/8W PRES			EA	2.000
	4.....	201-604000	RES 604 01% 1/8W PRES			EA	1.000
	4.....	201-619200	RES 61.9K 01% 1/8W PRES			EA	1.000
	4.....	201-825000	RES 825 01% 1/8W PRES			EA	1.000
	3.....	465-001200	2090 REAR PANEL BAY 2			EA	1.000
	4.....	015-706300	PIN/350663-6 AMP SPOOL			EA	12.000
	4.....	015-706400	PIN/350665-2 AMP SPOOL			EA	12.000
	4.....	019-708700	XFORMER/DJ346			EA	1.000
	4.....	024-711500	CON/5F CIR/SOL SWC 61HA5F			EA	1.000
	4.....	024-711600	CON/5M CIR/SOL SWC 12CL5M			EA	1.000
	4.....	024-721400	CON/1F CXL/SOL APH 31-010			EA	2.000
	4.....	024-721600	CON/4F REC/CRP AMP 1-350240-9			EA	1.000
	4.....	024-723300	CON/2F REC/CRP AMP 1-350354-9			EA	1.000
	4.....	024-724600	CON/10F REC/IDP MMM 3473-6000			EA	1.000
	4.....	024-726900	CON/6F REC/CRP AMP 1-350241-9			EA	1.000
	4.....	024-730800	CONN/15 PIN 1-350237-9			EA	1.000
	4.....	025-727500	SW/CW/GF-642			EA	2.000
	4.....	068-726608	PAN/2090 REAR BAY 2	X		EA	1.000
	4.....	070-701100	FUSE/348890 BODY			EA	1.000
	4.....	070-701200	FUSE/348007 CAP			EA	1.000
	4.....	102-700200	MOVISTOR/V130LA10A			EA	2.000
	4.....	114-701800	FLTR/6 AMP 6H9 CORCOM			EA	1.000
	3.....	465-001300	2090 REAR PANEL BAY 1			EA	1.000
	4.....	415-005200	2090 CAP BD P.S. BAY 1			EA	1.000
	5.....	000-900106	P.C.B./CAP BD/EXP SERIES	X		EA	1.000
	5.....	015-706300	PIN/350663-6 AMP SPOOL			EA	12.000
	5.....	015-706400	PIN/350665-2 AMP SPOOL			EA	12.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002300			2090-3C/DISK & DIGITAL I/O				1
	5.....	023-716200	CAP 8800MF 25V ALUM S CAL			EA	2.000
	5.....	023-717500	CAP 28KMF 15V ALUM S MEP			EA	2.000
	5.....	023-719000	CAP 2000MF 50V ALUM S CAL			EA	2.000
	5.....	024-719900	CON/15F REC/CRP AMP 1-350244-9			EA	1.000
	5.....	024-721800	CON/12M REC/CRP AMP 1-350236-9			EA	1.000
	5.....	085-702400	CORD/428-=056 ROTRON			EA	1.000
	4.....	475-002500	MECH MISC/BAY 1 P.S.			EA	1.000
	5.....	022-713800	DIO RECT SCPE05 50V 5A Q SEM			EA	1.000
	5.....	068-726706	PAN/2090 REAR BAY 1	X		EA	1.000
	5.....	072-700100	FAN/WISPER WR2A1			EA	1.000
	5.....	114-702600	FLTR./FAN/PAMOTER#5502			EA	1.000
	2.....	645-000500	2090 BAY 3 POWER SUPPLY			EA	1.000
	3.....	415-005500	2090 POWER SUPPLY BD BAY 3			EA	1.000
	4.....	000-902103	P.C.B./2090 BAY 3 SUPPLY	X		EA	1.000
	4.....	006-701400	WASH/NO J TEFLON			EA	4.000
	4.....	011-721900	BRKT/THIRD BAY P.S./2090.3	X		EA	2.000
	4.....	015-706300	PIN/350663-6 AMP SPOOL			EA	6.000
	4.....	021-708800	TRN NPN 2N5301 40V 200W D MOT			EA	2.000
	4.....	022-700800	DIO RECT 1N4004 400V 1A G TXI			EA	6.000
	4.....	022-707100	DIO TRRM 3SM2 200V 2A G SEM			EA	4.000
	4.....	023-700200	CAP 1000PF 300V 5% MICA R ARC			EA	2.000
	4.....	023-704700	CAP 1MF 35V 10% TANT G KEM			EA	1.000
	4.....	023-711000	CAP 22MF 35V 10% TANT G KEM			EA	4.000
	4.....	023-714000	CAP 100MF 50V ALUM G SPG			EA	1.000
	4.....	023-716200	CAP 8800MF 25V ALUM S CAL			EA	2.000
	4.....	023-717500	CAP 28KMF 15V ALUM S MEP			EA	1.000
	4.....	024-719500	CON/9M HDR/SOL AMP 9-350262-1			EA	1.000
	4.....	024-726900	CON/6F REC/CRP AMP 1-350241-9			EA	1.000
	4.....	026-705400	POT/500 PCB DAL 784-20-501			EA	2.000
	4.....	032-700800	INSUL/DIODE			EA	2.000
	4.....	098-704700	HT SNK/THM6006B-2-2			EA	1.000
	4.....	106-701800	RES .18 10% 2W			EA	1.000
	4.....	106-702700	RES .36 05% 2W			EA	1.000
	4.....	108-022200	RES 2.2K 05% 1/4W			EA	2.000
	4.....	108-027100	RES 270 05% 1/4W			EA	2.000
	4.....	121-702400	REG -1.2TO-37V 1.5A 337T E NAT			EA	1.000
	4.....	121-702600	REG 2TO38V .15A LAS1000 A LAM			EA	2.000
	4.....	201-124000	RES 124 01% 1/8W PRES			EA	1.000
	4.....	201-150000	RES 150 01% 1/8W PRES			EA	1.000
	4.....	201-200100	RES 2K 01% 1/8W PRES			EA	1.000
	4.....	201-301000	RES 301 01% 1/8W PRES			EA	2.000
	4.....	201-365000	RES 365 01% 1/8W PRES			EA	1.000
	4.....	201-604000	RES 604 01% 1/8W PRES			EA	2.000
	4.....	201-681900	RES 68.1 01% 1/8W PRES			EA	1.000
	3.....	475-003100	MECH MISC/BAY 3 P.S.			EA	1.000
	4.....	002-706500	PLATE/I/O COVER	X		EA	1.000
	4.....	015-706300	PIN/350663-6 AMP SPOOL			EA	6.000
	4.....	015-706400	PIN/350665-2 AMP SPOOL			EA	6.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002300			2090-3C/DISK & DIGITAL I/O				1
	4.....	019-707700	XFORMER/DG-447 FOREST			EA	1.000
	4.....	024-719800	CON/9F REC/CRP AMP 1-350242-9			EA	1.000
	4.....	024-727000	CON/6M REC/CRP AMP 1-350234-9			EA	1.000
	4.....	068-728003	FAN/2090 REAR BAY 3	X		EA	1.000
	4.....	070-703000	FUSE/SLO BLO 3AG3			EA	2.000
	1.....	845-000400	DISK-B ADD			EA	1.000
	2.....	415-005700	2090 DISK BD			EA	1.000
	3.....	000-901903	PCB/2090	X		EA	1.000
	3.....	015-701500	PIN/SOC 61173-1			EA	4.000
	3.....	019-707800	INDUCT/NYTRONICS/WEE 0.47UH			EA	1.000
	3.....	022-709400	DIO TRRF 1N4150 50V .2A G TXI			EA	1.000
	3.....	023-029200	CAP 22MF 15V 10% TANT G KEM			EA	3.000
	3.....	023-700300	CAP 500PF 500V 5% MICA R ARC			EA	3.000
	3.....	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	1.000
	3.....	023-710600	CAP 10PF 1000V 10% CERM R CLB			EA	1.000
	3.....	023-715100	CAP .05MF 50V CERM R ARC			EA	6.000
	3.....	024-703600	CON/4F REC/CRP AMP 1-480424-0			EA	1.000
	3.....	024-715900	CON/16F DIP/SOL AMP 640358-3			EA	4.000
	3.....	024-733200	CON/6M HDR/SOL AMP 9-350259-2			EA	1.000
	3.....	024-734000	CONN/IC SOC/20 PIN			EA	3.000
	3.....	024-734400	CON/18F DIP/SOL AMP 640359-3			EA	4.000
	3.....	024-745000	CON/64F DIP/SOL BDY DILBQ64P			EA	1.000
	3.....	025-718000	SW/C + K #8531			EA	1.000
	3.....	026-705700	POT/5K PCB DAL 784-20-502			EA	1.000
	3.....	085-709100	CBL/34 COND/AP 922523-34-99-12			EA	1.000
	3.....	100-700700	RES NET/CSP10E-01-502J			EA	2.000
	3.....	108-010000	RES 10 05% 1/4W			EA	4.000
	3.....	108-010100	RES 100 05% 1/4W			EA	1.000
	3.....	108-010200	RES 1K 05% 1/4W			EA	3.000
	3.....	108-010300	RES 10K 05% 1/4W			EA	5.000
	3.....	108-012300	RES 12K 05% 1/4W			EA	1.000
	3.....	108-015100	RES 150 05% 1/4W			EA	2.000
	3.....	108-027100	RES 270 05% 1/4W			EA	1.000
	3.....	108-033100	RES 330 05% 1/4W			EA	7.000
	3.....	108-047200	RES 4.7K 05% 1/4W			EA	2.000
	3.....	134-705303	IC/7404N HEX INVERTER			EA	1.000
	3.....	134-712803	IC/74LS00N 2-NAND			EA	4.000
	3.....	134-712903	IC/74LS04N HEX INVERTER			EA	1.000
	3.....	134-713203	IC/74LS74N FLIP-FLOP			EA	8.000
	3.....	134-716903	IC/74148N PRIORITY ENCODER			EA	1.000
	3.....	134-717503	IC/74S138N DEMULTIPLEXER			EA	1.000
	3.....	134-718103	IC/74LS191N COUNTER			EA	1.000
	3.....	134-720403	IC/74LS02N 2-NOR			EA	3.000
	3.....	134-720503	IC/74LS174N REGISTER			EA	2.000
	3.....	134-720803	IC/74LS10N 3-NAND			EA	1.000
	3.....	134-722005	IC/4040B CMOS 12 STAGE BIN COU			EA	1.000
	3.....	134-722403	IC/74LS139N MU[illegible]IPLEXER			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002300			2090-3C/DISK & DIGITAL I/O				1
	3.....	134-728803	IC/74S472 PROM			EA	2.000
	3.....	134-730903	IC/74LS367N HEX DRIVER			EA	4.000
	3.....	134-731300	IC/9900JL PROCESSOR			EA	1.000
	3.....	134-731403	IC/74LS362N CLOCK DRIVER			EA	1.000
	3.....	134-731503	IC/74LS259N ADDRESSABLE LATCH			EA	3.000
	3.....	134-731603	IC/74LS251N MULTIPLEXER			EA	4.000
	3.....	134-731700	IC/2111A-4N 256 X 4 STATIC RAM			EA	4.000
	3.....	134-731803	IC/74LS155N DEMULTIPLEXER			EA	1.000
	3.....	134-731903	IC/74LS395N SHIFT REGISTER			EA	4.000
	3.....	134-732003	IC/74LS92N COUNTER			EA	1.000
	3.....	134-732100	IC/96L02 MONOSTABLE			EA	1.000
	3.....	191-705400	CRYSTAL/48MHZ/.05%			EA	1.000
	3.....	201-200200	RES 20K 01% 1/8W PRES			EA	1.000
	3.....	201-250200	RES 25K 01% 1/8W PRES			EA	1.000
	2.....	465-001500	2090 DISK FRONT PANEL			EA	1.000
	3.....	000-902001	P.C.B./LED BD/MINI DISK/EXP	X		EA	1.000
	3.....	011-722403	BRKT/DISK/EXP	X		EA	1.000
	3.....	022-707900	DIO LEDR FLV110 1.7V 20MAL FCH			EA	4.000
	3.....	022-714800	DIO LEDG FLV340 2.3V20MA L FCH			EA	8.000
	3.....	025-715500	SW/PA166-011-0AA			EA	1.000
	3.....	025-718100	SW/7215J612ZCE-2 C&K			EA	2.000
	3.....	025-719600	SW/7101J60 C+K			EA	9.000
	3.....	045-703301	KNOB/KX-12322 1/8"			EA	1.000
	3.....	068-727806	FAN/2090 DISK FRONT	X		EA	1.000
	3.....	068-740901	PAN/2090 DISK FRONT SUB	X		EA	1.000
	3.....	085-709000	CBL/34 COND/AP 922522-34-99-06			EA	1.000
	2.....	475-001800	2090 DISK MECH ASSY			EA	1.000
	3.....	020-702700	CHAS/2090 DISK SLIDE			EA	1.000
	3.....	034-715500	GUIDE/SCANBE 11633-1			EA	4.000
	3.....	222-009000	DISK DRIVE/SHUGART #SA400			EA	1.000
	3.....	270-700800	DISK/DYSAN 140/1			EA	2.000
	1.....	845-000700	DIGITAL I/O - A ADD			EA	1.000
	2.....	415-006800	I/O CONN CARD			EA	1.000
	3.....	000-902401	P.C.B./I/O CARD/2090-3	X		EA	1.000
	3.....	011-721000	BRKT/PWR SPLY MTG/2090	X		EA	1.000
	3.....	134-715303	IC/7438N O/C 2-NAND			EA	5.000
	2.....	415-007400	2090 DIGITAL I/O BD			EA	1.000
	3.....	000-902205	PCB/2090 I/O	X		EA	1.000
	3.....	015-706400	PIN/350665-2 AMP SPOOL			EA	6.000
	3.....	023-700200	CAP 1000PF 300V 5% MICA R ARC			EA	1.000
	3.....	023-702400	CAP .01MF 100V 20% CERM R SPG			EA	6.000
	3.....	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	8.000
	3.....	024-723400	CON/2M HDR/SOL AMP 9-350360-1			EA	1.000
	3.....	024-726900	CON/6F REC/CRP AMP 1-350241-9			EA	1.000
	3.....	024-733200	CON/6M HDR/SOL AMP 9-350259-2			EA	1.000
	3.....	024-734000	CONN/IC SOC/20 PIN			EA	2.000
	3.....	024-737200	CONN/56PIN/AMP 67907.3			EA	1.000
	3.....	085-707700	CBL/50 COND/7 IN./SPEC			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002300			2090-3C/DISK & DIGITAL I/O				1
	3.....	100-700700	RES NET/CSP10E-01-502J			EA	2.000
	3.....	108-010300	RES 10K 05% 1/4W			EA	4.000
	3.....	108-033100	RES 330 05% 1/4W			EA	1.000
	3.....	134-712803	IC/74LS00N 2-NAND			EA	3.000
	3.....	134-712903	IC/74LS04N HEX INVERTER			EA	3.000
	3.....	134-713203	IC/74LS74N FLIP-FLOP			EA	4.000
	3.....	134-713703	IC/74LS253N MULTIPLEXER			EA	1.000
	3.....	134-715303	IC/7438N O/C 2-NAND			EA	2.000
	3.....	134-718803	IC/74LS175N REGISTER			EA	3.000
	3.....	134-720403	IC/74LS02N 2-NOR			EA	2.000
	3.....	134-720503	IC/74LS174N REGISTER			EA	5.000
	3.....	134-721203	IC/74LS163N COUNTER			EA	2.000
	3.....	134-722403	IC/74LS139N MULTIPLEXER			EA	1.000
	3.....	134-723003	IC/74LS14N HEX INVERTER			EA	4.000
	3.....	134-723903	IC/74LS257 MULTIPLEXER			EA	6.000
	3.....	134-728803	IC/74S472 PROM			EA	2.000
	3.....	134-730903	IC/74LS367N HEX DRIVER			EA	4.000
	3.....	134-731003	IC/74LS138N MULTIPLEXER			EA	2.000
	3.....	134-731903	IC/74LS395N SHIFT REGISTER			EA	4.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002700			NIC 2081				1
	1.....	415-009100	2081 GPIB I/O BD			EA	1.000
	2.....	000-904102	PCB/GP IR BD/2081	X		EA	1.000
	2.....	022-709400	DIO TRRF 1N4150 50V .2A G TXI			EA	2.000
	2.....	023-029200	CAP 22MF 15V 10% TANT G KEM			EA	1.000
	2.....	023-700300	CAP 500PF 500V 5% MICA R ARC			EA	2.000
	2.....	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	1.000
	2.....	023-715100	CAP .05MF 50V CERM R ARC			EA	3.000
	2.....	024-737200	CONN/56PIN/AMP 67907.3			EA	1.000
	2.....	024-742200	CONN/AMP 552230-1			EA	1.000
	2.....	025-731800	SW/TH 1P1T8 AM 1-435668-8			EA	1.000
	2.....	093-702700	FASTNER/CON/HWD AMP 552633-2			EA	1.000
	2.....	100-700700	RES NET/CSP10E-01-502J			EA	1.000
	2.....	108-010100	RES 100 05% 1/4W			EA	2.000
	2.....	134-712803	IC/74LS00N 2-NAND			EA	1.000
	2.....	134-712903	IC/74LS04N HEX INVERTER			EA	1.000
	2.....	134-713203	IC/74LS74N FLIP-FLOP			EA	2.000
	2.....	134-718803	IC/74LS175N REGISTER			EA	2.000
	2.....	134-720403	IC/74LS02N 2-NOR			EA	2.000
	2.....	134-722703	IC/74LS08N 2-AND			EA	1.000
	2.....	134-731503	IC/74LS259N ADDRESSABLE LATCH			EA	2.000
	2.....	134-731603	IC/74LS251N MULTIPLEXER			EA	2.000
	2.....	134-740903	IC/74LS240N OCTAL BUFFER			EA	1.000
	2.....	134-742400	IC/3446 488 TRANSCEIVER			EA	4.000
	1.....	415-009200	2081/82 I/O CPU			EA	1.000
	2.....	000-904204	PCB/2081/82 I/O CPU	X		EA	1.000
	2.....	011-721000	BRKT/PWR SPLY MTG/2090	X		EA	1.000
	2.....	011-725701	BRKT/MTG/2081	X		EA	3.000
	2.....	015-706400	PIN/350665-2 AMP SPOOL			EA	6.000
	2.....	019-707800	INDUCT/NYTRONICS/WEE 0.47UH			EA	1.000
	2.....	022-709400	DIO TRRF 1N4150 50V .2A G TXI			EA	1.000
	2.....	023-029200	CAP 22MF 15V 10% TANT G KEM			EA	4.000
	2.....	023-710600	CAP 10PF 1000V 10% CERM R CLB			EA	1.000
	2.....	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	1.000
	2.....	023-715100	CAP .05MF 50V CERM R ARC			EA	12.000
	2.....	024-721300	CON/24F DIP/SOL AMP 640361-3			EA	2.000
	2.....	024-726900	CON/6F REC/CRP AMP 1-350241-9			EA	1.000
	2.....	024-733200	CON/6M HDR/SOL AMP 9-350259-2			EA	1.000
	2.....	024-734000	CONN/IC SOC/20 PIN			EA	6.000
	2.....	024-734400	CON/18F DIP/SOL AMP 640359-3			EA	4.000
	2.....	025-718000	SW/C + K #8531			EA	1.000
	2.....	108-010000	RES 10 05% 1/4W			EA	4.000
	2.....	108-010100	RES 100 05% 1/4W			EA	1.000
	2.....	108-010200	RES 1K 05% 1/4W			EA	1.000
	2.....	108-010300	RES 10K 05% 1/4W			EA	1.000
	2.....	108-012300	RES 12K 05% 1/4W			EA	1.000
	2.....	108-047200	RES 4.7K 05% 1/4W			EA	3.000
	2.....	134-712803	IC/74LS00N 2-NAND			EA	1.000
	2.....	134-713203	IC/74LS74N FLIP-FLOP			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002700			NIC 2081				1
	2	134-716903	IC/74148N PRIORITY ENCODER			EA	1.000
	2	134-718803	IC/74LS175N REGISTER			EA	3.000
	2	134-720403	IC/74LS02N 2-NOR			EA	1.000
	2	134-728803	IC/74S472 PROM			EA	1.000
	2	134-731300	IC/9900JL PROCESSOR			EA	1.000
	2	134-731403	IC/74LS362N CLOCK DRIVER			EA	1.000
	2	134-731503	IC/74LS259N ADDRESSABLE LATCH			EA	2.000
	2	134-731603	IC/74LS251N MULTIPLEXER			EA	1.000
	2	134-731700	IC/2111A-4N 256 X 4 STATIC RAM			EA	4.000
	2	134-731803	IC/74LS155N DEMULTIPLEXER			EA	1.000
	2	134-736803	IC/74LS374N REGISTER			EA	1.000
	2	134-739103	IC/74LS244N OCTAL BUFFER			EA	3.000
	2	134-741400	IC/2716 MOS EPROM			EA	2.000
	2	191-705400	CRYSTAL/48MHZ/.05%			EA	1.000
	1	475-003200	2081 MECH ASSY			EA	1.000
	2	042-718501	COVER/2081 I/O	X		EA	1.000
	2	093-701900	FASTNR/BUT HD. SCR.			EA	4.000
	2	123-706900	HDWR MISC/KNURL SER. RAF598-SS			EA	3.000
	2	123-707000	HDWR MISC/RET.RING/RAF1058-SS			EA	3.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
885-002900			2082/RS232C I.O.				1
	1	405-001600	2082/CABLE			EA	1.000
	2	085-900300	CBL/2082 RS-232-C INTERCONNECT			EA	1.000
	1	415-009200	2081/82 I/O CPU			EA	1.000
	2	000-904204	PCB/2081/82 I/O CPU	X		EA	1.000
	2	011-721000	BRKT/PWR SPLY MTG/2090	X		EA	1.000
	2	011-725701	BRKT/MTG/2081	X		EA	3.000
	2	015-706400	PIN/350665-2 AMP SPOOL			EA	6.000
	2	019-707800	INDUCT/NYTRONICS/WEE 0.47UH			EA	1.000
	2	022-709400	DIO TRRF 1N4150 50V .2A G TXI			EA	1.000
	2	023-029200	CAP 22MF 15V 10% TANT G KEM			EA	4.000
	2	023-710600	CAP 10PF 1000V 10% CERM R CLB			EA	1.000
	2	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	1.000
	2	023-715100	CAP .05MF 50V CERM R ARC			EA	12.000
	2	024-721300	CON/24F DIP/SOL AMP 640361-3			EA	2.000
	2	024-726900	CON/6F REC/CRP AMP 1-350241-9			EA	1.000
	2	024-733200	CON/6M HDR/SOL AMP 9-350259-2			EA	1.000
	2	024-734000	CONN/IC SOC/20 PIN			EA	6.000
	2	024-734400	CON/18F DIP/SOL AMP 640359-3			EA	4.000
	2	025-718000	SW/C + K #8531			EA	1.000
	2	108-010000	RES 10 05% 1/4W			EA	4.000
	2	108-010100	RES 100 05% 1/4W			EA	1.000
	2	108-010200	RES 1K 05% 1/4W			EA	1.000
	2	108-010300	RES 10K 05% 1/4W			EA	1.000
	2	108-012300	RES 12K 05% 1/4W			EA	1.000
	2	108-047200	RES 4.7K 05% 1/4W			EA	3.000
	2	134-712803	IC/74LS00N 2-NAND			EA	1.000
	2	134-713203	IC/74LS74N FLIP-FLOP			EA	1.000
	2	134-716903	IC/74148N PRIORITY ENCODER			EA	1.000
	2	134-718803	IC/74LS175N REGISTER			EA	3.000
	2	134-720403	IC/74LS02N 2-NOR			EA	1.000
	2	134-728803	IC/74S472 PROM			EA	1.000
	2	134-731300	IC/9900JL PROCESSOR			EA	1.000
	2	134-731403	IC/74LS362N CLOCK DRIVER			EA	1.000
	2	134-731503	IC/74LS259N ADDRESSABLE LATCH			EA	2.000
	2	134-731603	IC/74LS251N MULTIPLEXER			EA	1.000
	2	134-731700	IC/2111A-4N 256 X 4 STATIC RAM			EA	4.000
	2	134-731803	IC/74LS155N DEMULTIPLEXER			EA	1.000
	2	134-736803	IC/74LS374N REGISTER			EA	1.000
	2	134-739103	IC/74LS244N OCTAL BUFFER			EA	3.000
	2	134-741400	IC/2716 MOS EPROM			EA	2.000
	2	191-705400	CRYSTAL/48MHZ/.05%			EA	1.000
	1	415-009900	2082/ I/O BOARD			EA	1.000
	2	000-904502	PCB/2082 I/O	X		EA	1.000
	2	019-709300	INDUCT/40 UH @ 100 MA BIAS	X		EA	2.000
	2	019-709400	INDUCT/360 UH @ 100 MA BIAS	X		EA	1.000
	2	022-709400	DIO TRRF 1N4150 50V .2A G TXI			EA	2.000
	2	023-029200	CAP 22MF 15V 10% TANT G KEM			EA	4.000
	2	023-700100	CAP 100PF 500V 5% MICA R ARC			EA	1.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
805-002900			2082/RS232C I.O.				1
	2.....	023-711000	CAP 22MF 35V 10% TANT G KEM			EA	1.000
	2.....	023-711100	CAP 4.7MF 10V 10% TANT G KEM			EA	1.000
	2.....	023-715100	CAP .05MF 50V CERM R ARC			EA	6.000
	2.....	024-723100	CON/25F REC/SOL AMP 205738-1			EA	1.000
	2.....	024-723200	CON/25M REC/SOL AMP 205737-1			EA	1.000
	2.....	024-734400	CON/18F DIP/SOL AMP 640359-3			EA	1.000
	2.....	024-737200	CONN/56PIN/AMP 67907.3			EA	1.000
	2.....	025-721100	SW/ALCO MSS-4200			EA	1.000
	2.....	025-731800	SW/TH 1P1T8 AM 1-435668-8			EA	1.000
	2.....	051-700700	BUMPER/SJ-5017			EA	2.000
	2.....	093-702100	FASTNER/SCR LOCK			EA	2.000
	2.....	100-700700	RES NET/CSP10E-01-502J			EA	1.000
	2.....	101-010900	RES 1 10% 1/2W			EA	1.000
	2.....	134-712803	IC/74LS00N 2-NAND			EA	1.000
	2.....	134-713203	IC/74LS74N FLIP-FLOP			EA	1.000
	2.....	134-731503	IC/74LS259N ADDRESSABLE LATCH			EA	1.000
	2.....	134-731603	IC/74LS251N MULTIPLEXER			EA	2.000
	2.....	134-741503	IC/497AC SWITCHING VOLT REG			EA	1.000
	2.....	134-741600	IC/9902 CRU UART			EA	1.000
	2.....	134-741703	IC/75188 QUAD LINE DRIVER			EA	2.000
	2.....	134-741803	IC/75189 QUAD LINE RECEIVER			EA	2.000
	2.....	201-110200	RES 11K 01% 1/8W PRES			EA	1.000
	2.....	201-127100	RES 1.27K 01% 1/8W PRES			EA	1.000
	1.....	475-003600	2082/ MECH ASSY			EA	1.000
	2.....	042-719502	COVER/2082 I/O	X		EA	1.000
	2.....	093-701900	FASTNR/BUT HD. SCR.			EA	4.000
	2.....	123-706900	HDWR MISC/KNURL SER. RAF598-SS			EA	3.000
	2.....	123-707000	HDWR MISC/RET.RING/RAF1058-SS			EA	3.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
845-000900			2085 CAL I/O				1
	1	415-007500	CALCULATOR BD/2085			EA	1.000
	2	000-902601	PCB/2085 CALCULATOR	X		EA	1.000
	2	022-701100	DIO GERM 1N270 80V .2A G ITT			EA	1.000
	2	023-700300	CAP 500PF 500V 5% MICA R ARC			EA	1.000
	2	024-737200	CONN/56PIN/AMP 67907.3			EA	1.000
	2	085-705800	CBL/98032A H.P.			EA	1.000
	2	100-701700	RES NET/BECK 785-5-R-220/330			EA	2.000
	2	108-015100	RES 150 05% 1/4W			EA	1.000
	2	108-022100	RES 220 05% 1/4W			EA	1.000
	2	108-027100	RES 270 05% 1/4W			EA	1.000
	2	108-033100	RES 330 05% 1/4W			EA	1.000
	2	134-709703	IC/74121N MONOSTABLE			EA	1.000
	2	134-731803	IC/74LS155N DEMULTIPLEXER			EA	1.000
	1	475-002800	MECH MISC/2085			EA	1.000
	2	042-713200	COVER/CAL.I/O/9825A CAL	X		EA	1.000
	2	093-702400	FASTNR/SCR 6-32 X 1/4" BLK			EA	4.000
	2	123-706900	HDWR MISC/KNURL SER. RAF598-SS			EA	3.000
	2	123-707000	HDWR MISC/RET.RING/RAF1058-SS			EA	3.000

ASSEMBLY	LEVEL	COMPONENT	DESCRIPTION	ENG DWG	VENDOR	U/M	QTY
845-000800			OPTION 003				1
	1.....	415-006900	I/O BD/OPT 003			EA	1.000
	2.....	000-902502	PCB/2090 I/O ACC	X		EA	1.000
	2.....	024-713000	CON/50M HDR/IDP MMM 3426-0000			EA	2.000
	2.....	024-713500	CONN/3425-0000			EA	2.000
	2.....	024-737200	CONN/56PIN/AMP 67907.3			EA	1.000
	2.....	100-701700	RES NET/BECK 785-5-R-220/330			EA	3.000
	2.....	108-022100	RES 220 05% 1/4W			EA	1.000
	2.....	108-033100	RES 330 05% 1/4W			EA	1.000
	1.....	475-002700	MECH MISC/OPT. 003			EA	1.000
	2.....	042-711502	COVER/I/O/002-003			EA	1.000
	2.....	093-701900	FASTNR/BUT HD. SCR.			EA	4.000
	2.....	123-706900	HDWR MISC/KNURL SER. RAF598-SS			EA	3.000
	2.....	123-707000	HDWR MISC/RET.RING/RAF1058-SS			EA	3.000

NIC-2081 OPERATION

IEEE-488 FUNCTION SUBSETS

SH1	Source Handshake - complete capability
AH1	Accepter Handshake - complete capability
T6	Basic Talker, Serial poll, & Unaddress if MLA
L4	Basic Listener & Unaddress if MTA
SR1	Service Request - complete capability
RLØ	Remote Local - no capability
PPØ	Parallel Poll - no capability
DC1	Device Clear - complete capability
DTØ	Device Trigger - no capability
CØ	Controller - no capability

IEEE-488 BUS ADDRESSING

The external box on the back of the 2090 contains a DIP switch which is used to set the primary address for the NIC-2081. When the NIC-2081 is set to talk or listen at this primary address it will transfer data between the 2090 and the GP-IB. The mode of data transfer is selected by addressing the NIC-2081 to listen at a primary address equal to the DIP switch setting plus one.

Summarizing

1. The NIC-2081 has a primary listen address and a primary talk address equal to the DIP switching setting. This address is used for data transfer.
2. The NIC-2081 also has a primary listen address which is equal to the DIP switch setting plus one. This address is used for mode selection on the data transfer and operation of some other 2090 features.

   NOTE: There is no primary talk address at DIP switch plus one.

NIC-2081 MODE CONTROL CHARACTERS

The mode control characters are sent to the NIC-2081 at a primary listen address equal to the DIP switch setting plus one. The mode control characters are ASCII characters. Any other ASCII characters that are sent to the NIC-2081 and not listed below will be ignored.

LØ - Live — This command places the plug-in unit in the "Live" mode. And a SRQ is sent out when the plug-in unit goes to "Hold".

HØ - Live; Hold Next — This command activates both the LIVE and HOLD NEXT pushbuttons on the plug-in unit. It also sends out a SRQ when the plug-in unit goes to "Hold".

H1 - Live; Hold Last — This command activates both the LIVE and HOLD LAST pushbuttons on the plug-in unit. It also sends out a SRQ when the plug-in unit goes to "Hold".

H2 - Abort Sweep — This command cancels a sweep in progress.

NOTE: Commands R, S, T & H3 are used if the 2090 has a magnetic disk memory.

H3 - Activate Autocycle — This command activates the autocycle mode if that mode is selected on the disk memory unit. A SRQ is sent out when the autocycle is completed.

Rn - Recall — This command recalls disk track-n. If n is 1 through 8 that respective track is recalled. If n is Ø the current track, indicated on the front panel, is recalled. A SRQ is sent out when the transfer is complete.

Sn - Store	This command stores disk track-n. If n is 1 through 8 that respective track is stored. If n is Ø the current track, indicated on the front panel, is stored. A SRQ is sent out when the transfer is complete.
Tn - Track	This command sets the track to n, if n is 1 through 8. If n is Ø the track is left unchanged.

The next four commands allow data to be transferred between the 2090 and the GP-IB. The data is actually the measured data points in the 2090 display memory. The data has a primary address equal to the DIP switch setting.

DØ - ASCII Data Auto Advance	This command transfers ASCII data and increments the data point address after each transfer.
D1 - ASCII Data Load Address	This command transfers ASCII data at a given ASCII data point address.
D2 - Binary Data Auto Advance	This command transfers binary data and increments the data point address after each transfer.
D3 - Binary Data Load Address	This command transfers binary data at a given binary data point address.
D4 - Status Out	This command sends out 2 - ASCII digits. The track number from the disk and a number that shows the setting of the MEMORY switch. If the NIC-2081 is addressed to listen in this mode it will operate like "DØ".

The next three commands allow normalizing information to be transferred between the 2090 and the GP-IB. Normalizing data contains voltage and time information. This information is ASCII only.

NØ - Standard Numbers	When the NIC-2081 is talking the original normalizing is sent out and during listen the input is placed in both the original and the numbers reset locations.
N1 - Original Numbers	This command transfers normalizing data only with the original normalizing location.
N2 - Reset Numbers	This command transfers normalizing data only with the numbers reset normalizing location.
	The next two commands allow a choice of ASCII delimiter characters.
EØ - CR/LF	This command causes all ASCII information sent out to have a carriage return and line feed as a terminator.
E1 - CR	This command causes all ASCII information sent out to have a carriage return as a terminator.

FORMAT

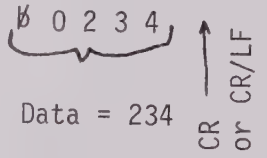
The characters listed below will be the information transferred on the 8-data lines used by the GP-IB, DIO1-DIO8.

Waveform Data Points:

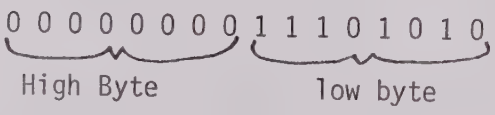
Waveform data points and data point addresses have a range of -2048 through 2047 and 0 through 4095, respectively. The top of the oscilloscope screen is 2047 and the bottom is -2048. The left of the screen is Ø.

This means that it takes 5 ASCII characters for the DØ and D1 mode to transfer one data point or to send in an address. The format must not use a decimal point. The binary modes, D2 and D3, transfer data using two 8-bit bytes as a 16-bit word. The high order byte is transferred first. The 16-bit word is in 2's compliment and has the range listed above.

ASCII format:



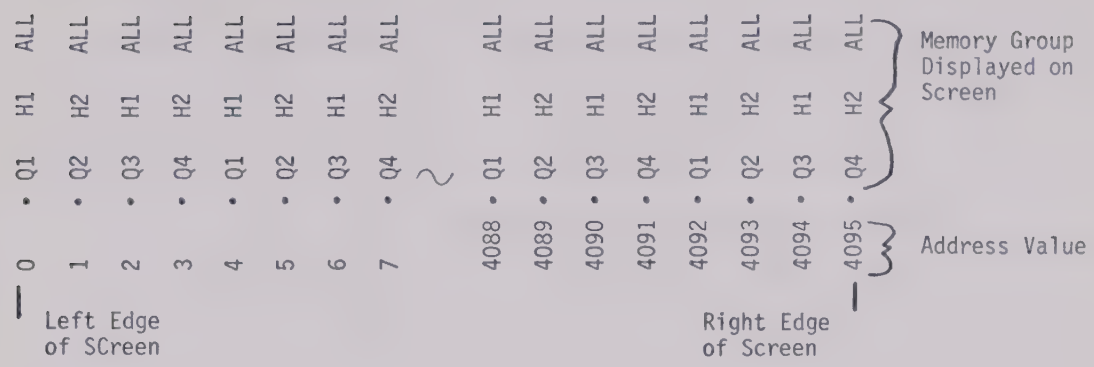
Binary format:



Data = 234

If the load address mode is used, i.e. D1 or D3, any data point can be accessed and in any order. The address of a data point is proportional to the time at which the data point was measured.

OSCILLOSCOPE SCREEN WITH ADDRESS VALUES SHOWN



The memory address counter is designed so only the displayed memory group can be accessed for data transfer. If a non-displayed memory group is addressed, the counterpart in the displayed group will be transferred. For example, if H1 is addressed and H2 is displayed, the data points of H2 will be transferred or if Q1 is addressed and H2 is displayed, the data points of Q2 will be transferred.

Normalizing:

This information is transferred in ASCII format only. There are seven items in each normalizing set, "N-set". These items are, in order, V-norm bit, H-norm bit, memory fraction, V-zero, H-zero, V-norm, and H-norm.

V-norm bit indicates that the voltage values are normalized if it is a 1 and not normalized if it is a Ø.

H-norm bit indicates that the time values are normalized if it is a 1 and not normalized if it is a Ø.

The memory fraction has a value of 1, 2, 4 or 8. The memory fraction is the memory address increment used to obtain the next data point on a waveform. The reciprocal of the memory fraction indicates the amount of memory used for the waveform at the time of measurement. A single channel ALL measurement is 4096 data points, memory fraction equals 1. A two channel H1 measurement is 1024 data points per waveform, memory fraction equals 4. Therefore the reciprocal of the memory fraction times 4096 equals the amount of data points on a waveform.

V-zero is the location of zero voltage with respect to the center of the screen and ranges from -2048 to 2047. For example, if V-zero equals -2048 the zero volts is at the very bottom of the oscilloscope screen and all voltages indicated on the screen will be positive.

H-zero is the address location for time zero with respect to the left edge of the oscilloscope screen. For example, if cursor trigger is used and the cursor is at address 1ØØ, during the measuremt. The values for time, shown on the screen, will be negative for addresses Ø to 99 and positive for addresses 101 to 4095.

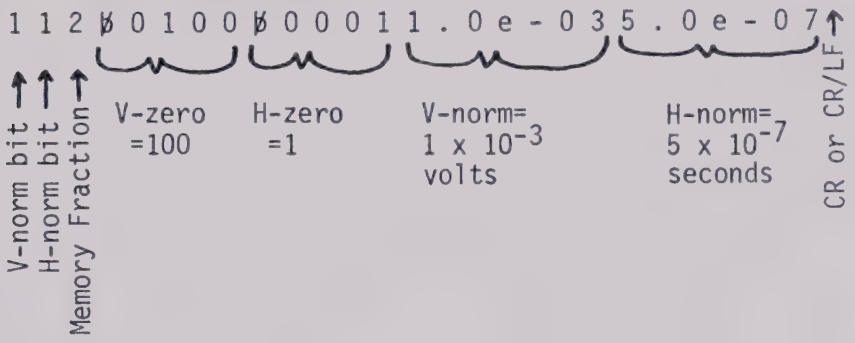
NOTE: V-zero and H-zero can be set by the scope operator using the NUMBERS RESET feature of the 2090 and using the "N2" command on the NIC-2081.

V-norm is a floating point number that shows the voltage between each level on the screen. If the data point value (-2048 to 2047) is multipled by V-norm the result will be the actual voltage at that data point. If V-norm is multiplied by 2000 the result will be the voltage range setting for that waveform.

H-norm is a floating point number that shows the time between each data point. It also equals the time per point setting.

NOTE: H-norm and V-norm range from 10^{-8} to 10^{+2} with multipliers of 1.0, 2.0 and 5.0.

Example of a normalizing set



The number of normalizing sets, N-sets, is shown below

Memory	N-set Count
ALL	8
Halves	4
Quarters	2

There are 8 N-sets in ALL memory to account for a maximum number of 8 waveforms which would be obtained by making 4 two-channel measurements in all four quarters. If a single channel measurement is done in ALL only one N-set need be read, but all 8 must be put back into the 2090 even though they are all the same.

Before normalzing is transferred, a normalizing command must be sent, i.e., NØ, N1, or N2. This action resets the N-set counter. No more than the N-set count should be transferred or the normalizing will be incorrect.

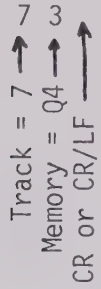
2090 Status - "D4"

This information is sent out to indicate disk memory track and the position of the MEMORY switch.

Memory Switch Number	Memory Switch Position
0	Q1
1	Q2
2	Q3
3	Q4
4	1H
5	2H
6	ALL
7	Open Switch

If the 2090 does not have a magnetic disk memory the track number will be 8.

"D4" output example:



I/O ACTIVE - Led on the right bay front panel

The I/O ACTIVE indicator has two functions.

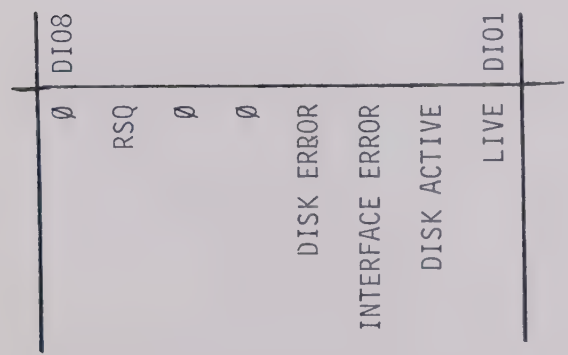
1. When the power is first applied to the 2090 the I/O ACTIVE led flashes on and then off in 0.2 sec. If the I/O ACTIVE led remains on during power up the NIC-2081 is inoperative and if the I/O ACTIVE led continues to flash on and off the external NIC-2081 circuit board is not attached to the 2090.
2. The I/O ACTIVE led also indicates when the NIC-2081 is addressed to talk or listen on the GP-IB. Therefore when the NIC-2081 is unaddressed the I/O ACTIVE led will be off.

GP-IB Commands

The GP-IB command of device clear, DCL, and selected device clear, SDC, are used to set the data point address to the left edge of the screen. These commands also unaddress the NIC-2081 off the bus.

The interface clear, IFC, signal sets the NIC-2081 back to power up status which is, unaddressed on the GP-IB and D1 data transfer mode.

The status byte, STB, used with serial-polling is shown below.



STATUS BYTE

If the controller being used does not have a command for reading the status, but can generate ASCII characters and can turn the ATTENTION line on and off, the STATUS BYTE can be read from the 2090. After doing a command that causes a service request, the SRQ line should be monitored. After the SRQ line goes true, the following steps can be used to read the status:

`0: cmd 7,"?"&char(24)&"5N"`	Turn ATT on; send ASCII "?", SPE character, enable scope talk and 9825A listen, turn ATT off.
`1: fmt 1,c1,z;red 731.1,A$`	Input 1 character into A$ w/o CR/LF (delimiter).
`2: dsp A$`	Displays the status character.
`3: clr 7`	Sends out a Device Clear character (DCL). Must be used to disable the SPE. A Selected Device Clear may be used (SDC).

The above example would not be used in the HP-9825A as a read status command is available (`rds (714)`).

NIC-2081 OPERATING SUGGESTIONS

If commands D, N, R, S or E are sent to the NIC-2081 the measurement in progress is aborted, i.e., the plug-in is forced into hold. Also the NIC-2081 waits for the disk to go inactive before any command is executed, i.e., L, H, T, D, N, R. S, or E. Therefore, if a command sequence of "HØDØ" is sent into the NIC-2081 the sweep will not be complete. It is best to do an "H" command, then test for "Hold" by using the status byte or SRQ, and then doing a "D" command.

There are two reasons to unaddress the NIC-2081 after an operation is complete.

1. The operator will know when the operation is complete when he sees the I/O ACTIVE led go out.
2. The magnetic disk memory cannot be activated with the I/O ACTIVE led on.

If data transfers are done with the magnetic disk memory it is best to rotate the disk mode switch all the way CCW to MAIN FRAME CONTROLLED and the memory switch to ALL . This way the whole track is accessible to the GP-IB. For example, if Q1 is to be modified using the GP-IB, recall the track, use D1 or D3 to address only Q1 and then store the track.

When normalizing is sent into the 2090 a normalizing set can be skipped by sending in a CR or CR/LF.

CHANGING TALK/LISTEN ADDRESSES

Setting each switch to the "ON" position corresponds to a "0" in the table.

Available GP-IB Addresses and Codes

	Address Characters (ASCII)		Address Switch Settings					Address Codes
	Listen	Talk	(5)	(4)	(3)	(2)	(1)	decimal
	SPACE	@	0	0	0	0	0	0
	!	A	0	0	0	0	1	1
	"	B	0	0	0	1	0	2
	#	C	0	0	0	1	1	3
	$	D	0	0	1	0	0	4
	%	E	0	0	1	0	1	5
	&	F	0	0	1	1	0	6
	'	G	0	0	1	1	1	7
	(	H	0	1	0	0	0	8
	)	I	0	1	0	0	1	9
	*	J	0	1	0	1	0	10
	+	K	0	1	0	1	1	11
	,	L	0	1	1	0	0	12
	-	M	0	1	1	0	1	13
factory preset →	.	N	0	1	1	1	0	14
	/	O	0	1	1	1	1	15
	0	P	1	0	0	0	0	16
	1	Q	1	0	0	0	1	17
	2	R	1	0	0	1	0	18
	3	S	1	0	0	1	1	19
	4	T	1	0	1	0	0	20
	5	U	1	0	1	0	1	21
	6	V	1	0	1	1	0	22
	7	W	1	0	1	1	1	23
	8	X	1	1	0	0	0	24
	9	Y	1	1	0	0	1	25
	:	Z	1	1	0	1	0	26
	;	[	1	1	0	1	1	27
	<	/	1	1	1	0	0	28
	=	]	1	1	1	0	1	29
	DO NOT USE		1	1	1	1	0	
	DO NOT USE		1	1	1	1	1	

Sample Programs for the HP-9825 Calculator

The sample programs shown below assume a 98034A select code of 7 and a Memory Group of ALL.

1. This program shows how to store all 4096 data points in the calculator using a string variable as a fast read/write buffer. This program also can be used to record waveforms on tape or load them from the tape cartridge back into the 2090. This program does not handle normalizing information. To transfer the waveform to the calculator press "RUN". The waveform is now in the string variable X$ and it can be recorded on tape. Press the ERASE pushbutton on the 2090 and then press "CONTINUE" on the calculator. This step brings back a stored waveform from the calculator.

To load a waveform from the tape cartridge into the 2090-3, press "RUN" and then load the string variable, X$, with the data points from the tape. Then press "CONTINUE" and the recorded waveform will appear on the screen of the 2090-3.

Enter the following program into the 9825A:

```
0: dim X$[8208]
1: buf "data",X$,3
2: wrt 715,"D2";clr 7
3: tfr 714,"data",8192
4: clr 7;stp
5: wrt 715,"D2";clr 7
6: tfr "data",714,8192
7: clr 7;end
*15932
```

Program comments:

This section reads the data from the 2090-3.

0: Dimension a string variable, X$, for 8208 bytes. This is for 4096 16-bit words plus 16 bytes of overhead for the fast read/write buffer.

1: Allocate a buffer called "data" which has also been dimensioned as a string variable, X$. The 3 stands for the type of buffer, i.e., a fast read/write buffer with a data format of 8-bit words.

2: Activate binary data-advance address mode. Clear Bus and set 2090 address to left edge of screen.

3: Transfer 4096 data points from the HP-IB card with select code 7 to a buffer called "data".

4: Clear Bus and stop program.

This section writes the data into the 2090-3 when "CONTINUE" is pressed.

5: Activate binary data-advance address mode. Clear Bus and set 2090 address to left edge of screen.

6: Transfer 4096 data points from a buffer called "data" to an HP-IB card with select code 7.

7: Clear Bus and end program.

2. This program stores all 4096 data points and has the same features as program "1", listed above, but this program uses the ASCII read and write statements for data transfer.

Enter the following program into the 9825A:

```
0: dim X$[8192]
1: fmt f5.0;clr 7
2: wrt 715,"D0"
3: cmd 7,"?5N"
4: for I=1 to 8192 by 2
5: red 731,N
6: fti (N)→X$[I,I+1]
7: next I
8: clr 7;stp
9: fmt f5.0;clr 7
10: wrt 715,"D0"
11: cmd 7,"?.U"
12: for I=1 to 8192 by 2
13: wrt 731,itf(X$[I,I+1])
14: next I
15: clr 7;end
*17955
```

Program comments:

This section reads the data from the 2090-3.

0: Dimension X$

1: Set format for 5 characters and no decimal point. Clear Bus and set 2090 address to left edge of screen.

2: Activate ASCII data-advance address mode.

3: At HP-IB card with select code 7 send out unlisten, 9825-talk address, and 2090-listen address.

4: Set up a "For-Next" loop for 4096 data points.

5: Read a data point into N. Address 31 is used to tell the calculator that the GP-IB has already been addressed. (This saves time.)

6: Convert the number in N from full precision to integer precision and store the two-byte number in the string, X$, at locations I and I + 1.

7: End of "For-Next" loop.

8: Clear Bus and stop program.

This section writes the data into the 2090-3 when "CONTINUE" is pressed.

9: Set format for 5 characters and no decimal pont. Clear Bus and set 2090 address to left edge of screen.

10: Activate ASCII data-advance address mode.

11: Bus commands: Unlisten, 2090-talk, and 9825-listen.

12: Set up a "For-Next" loop for 4096 data points.

13: Convert the integer stored in the string, X$, at locations I and I +1 back to full precision. Write that data point into the 2090-3.

14: End of the "For-Next" loop.

15: Clear Bus and end program.

3. This program stores the right half of the 2090 into the calculator using binary Load Address mode. It will store from the middle of the screen, then put it back into the 2090 starting at the left of the screen, duplicating the right half into the left half of the 2090.

Enter the following program into the 9825A:

```
0: dim X$[4096];clr 7
1: wrt 715,"D3"
2: for I=1 to 4096 by 2
3: cmd 7,"?U."
4: I/2+2047.5→A;wtb 731,rot(A,8),A
5: cmd 7,"?5N"
6: rdb(731)→B;rdb(731)→C;fti (ior(rot(B,8),C))→X$[I]
7: next I
8: cmd 7,"?U."
9: for I=1 to 4096 by 2
10: I/2-.5→A;wtb 731,rot(A,8),A
11: itf(X$[I])→B;wtb 731,rot(B,8),B
12: next I;clr 7
*23233
```

Program comments:

0: Dimension X$. Clear buss.

1: Activate Binary load address mode.

2: Set up FOR NEXT loop of 4096 bytes of data.

3: Buss commands, Unlisten, 9825A talk, 2090 Listen

4: Send out address.

5: Buss commands: Unlisten, 9825A listen, 2090 Talk

6: Read data and store into string.

7: Next

8: Buss Commands: Unlisten, 9825A Talk, 2090 Listen.

9: Set up FOR NEXT loop of 4096 bytes of data.

10: Send out address.

11: Send out data

12: Next, clear buss.

4. This program is like program 3, but ASCII Load address mode will be used. A ramp will be drawn on the screen from the lower left corner to the upper right corner. The ramp will be checked and any errors noted. This program can be used as a test program.

Enter following program into the 9825A.

```
0: fmt f5.0;clr 7
1: wrt 715,"E0D1"
2: cmd 7,"?U."
3: for I=-2048 to 2047
4: wrt 731,I+2048;wrt 731,I
5: next I
6: for I=-2048 to 2047
7: cmd 7,"?U."
8: wrt 731,I+2048
9: cmd 7,"?5N"
10: red 731,A
11: if A#I;prt "9825 =",I,"2090 =",A
12: next I;clr 7
*19781
```

Program comments:

0: Set up format. Clear buss

1: Set up. ASCII Load Address mode with CR/LF.

2: Buss commands, Unlisten, 9825A Talk, 2090 Listen

3: Set up FOR NEXT loop of 4096 addresses and data points.

4: Send out address and data.

5: Next.

6: Set up FOR NEXT loop of 4096 addresses and data points

7: Buss commands: Unlisten, 9825A Talk, 2090 Listen.

8: Send out address.

9: Buss commands: Unlisten, 9825A listen, 2090 Talk.

10: Read data.

11: Check data.

12: Next. Clear buss.

5. This program shows how to send and receive normalizing information. It can also be used as a test program. VZERO is at the bottom of the screen, so all numbers should be positive and HZERO is at the right edge of the screen, so all time numbers should be negative except for the right edge, which should be 0.

Enter the following program into the 9825A:

```
0: wrt 715,"N1"
1: fmt 1,3f1.0,2f5.0,2e7.1;1→A→B→C;-2048→D;4095→E;1e-3→F;1e-6→G
2: cmd 7,"?U."
3: for Z=1 to 8
4: wrt 731.1,A,B,C,D,E,F,G;next Z
5: wrt 715,"N1"
6: cmd 7,"?5N"
7: for Z=1 to 8
8: red 731.1,H,I,J,K,L,M,N
9: if H#A;prt "VNORM disp bad","9825 =",A,"2090 =",H
10: if I#B;prt "HNORM disp bad","9825 =",B,"2090 =",I
11: if J#C;prt "MF bad","9825 =",C,"2090 =",J
12: if K#D;prt "VZERO bad","9825 =",D,"2090 =",K
13: if L#E;prt "HZERO bad","9825 =",E,"2090 =",L
14: if M#F;prt "VNORM bad","9825 =",F,"2090 =",M
15: if N#G;prt "HNORM bad","9825 =",G,"2090 =",N
16: next Z;prt "2090 should be","displaying:","  1 us/pt","  1 mv/div";spc 2
17: clr 7
*5066
```

Program comments:

0: Set up Normalizing transfer mode.

1: Set up format and various values

2: Buss commands: Unlisten, 9825A Talk, 2090 Listen.

3: Set up FOR NEXT loop to send 8 N-sets.

4: Send 8 N-sets. Next.

5: Set up N mode again, to resent start address.

6: Buss commands: Unlisten, 9825A Listen, 2090 Talk

7: Set up FOR NEXT loop.

8: Read Normalization into registers.

9: Check VNORM display.

10: Check HNORM display.

11: Check MF

12: Check VZERO

13: Check HZERO

14: Check VNORM.

15: Check HNORM

16: Next. Final print statement.

17: Clear buss.

NIC-2082 CONNECTION & OPERATION (Version RS1B 4.0)

The NIC-2082 RS-232C interface has two connectors, one labeled TO MODEM and the other labeled TO TERMINAL. The TO MODEM connector is used to connect a computer to the 2090 directly or through a modem. All communication between the 2082 and the computer are done through the TO MODEM connection. The TO TERMINAL connector is used to connect an optional terminal or other similar device to the 2090. This allows the computer to still communicate with a terminal using only one RS-232C channel. The TO TERMINAL connection is only a means of communicating with a computer. It cannot control the 2082. If you desire to check out the interface using a terminal, consult the section "USING A PRINTER TO CONTROL THE 2082". The 2082 can operate both in half-duplex and full-duplex. Note that the terminal connected to the 2082 must match the bit-rate (baud) set on the 2082 and must match the duplex-mode of the modem, i.e., if a modem is half-duplex than the terminal must be half-duplex.

SPECIAL CONTROL CHARACTERS

SOH — This is an ASCII Control character which is the same as a Control-A and has a decimal value of 1. This character is used to enable the NIC-2082 interface and disable the terminals' printer. The I/O ACTIVE led will go on when an SOH is received and the NIC-2082 also enters the control mode. In this mode a data transfer can be set up using Dn, Nn, En and Innnn, or Onnnn. Or a plug-in or disk memory operation can be initiated.

STX — This is an ASCII Control character which is the same as a Control-B and has a decimal value of 2. This character is used to initiate the data transfer set up by control characters Dn, Nn, En and Innnn or Onnnn. The NIC-2082 input or output begins immediately after receiving the STX.

ETX — This is an ASCII Control character which is the same as a Control-C and has a decimal value of 3. This character is used to disable the NIC-2082 interface, at which time the terminal's printer is enabled and the I/O ACTIVE led is extinguished. The NIC-2082 is then put back into an idle state waiting for an SOH character.

NIC-2082 MODE CONTROL CHARACTERS

The mode control characters are sent to the NIC-2082 after a SOH is sent to the NIC-2082. The mode control characters are ASCII characters. Any other ASCII characters that are sent to the NIC-2082 and not listed below will be ignored. NOTE: Do not send CR or CR/LF after characters.

LØ - Live — This command places the plug-in unit in the "Live" mode and waits for manual activation of HOLD.

HØ - Live; Hold Next — This command activates both the LIVE and HOLD NEXT pushbuttons on the plug-in unit.

H1 - Live; Hold Last — This command activates both the LIVE and HOLD LAST pushbuttons on the plug-in unit.

H2 - Abort Sweep — This command cancels a sweep in progress.

NOTE: Commands R, S, T & H3 are used if the 2090 has a magnetic disk memory.

H3 - Activate Autocycle — This command activates the autocycle mode if that mode is selected on the disk memory unit.

Rn - Recall — This command recalls disk track-n. If n is 1 through 8 that respective track is recalled. If n is Ø the current track, indicated on the front panel, is recalled.

Sn - Store — This command stores disk track-n. If n is 1 through 8 that respective track is stored. If n is Ø the current track, indicated on the front panel, is stored.

Tn - Track — This command sets the track to n, if n is 1 through 8. If n is Ø the track is left unchanged.

The next four commands, DØ thru D3, set up the NIC-2082 to allow data to be transferred between the 2090 and the RS-232 channel. The data is actually the measured data points in the 2090 display memory. D4 and D5 sent out status information immediately.

DØ - ASCII Data Auto Advance — Transfer ASCII data and increment the data point's address after each transfer.

D1 - ASCII Data Load Address — Transfer ASCII data at a given ASCII data point address. This command clears the data point address.

D2 - Binary Data Auto Advance — Transfer binary data and increments the data point's address after each transfer.

D3 - Binary Data Load Address — Transfer binary data at a given binary data point address. This command clears the data point address.

D4 - Status Character — This command sends out the status character and delimiter.

D5 - Full Status — This command sends out 3 - ASCII digits. The track number from the disk, a number that shows the setting of the MEMORY switch, and the status character and delimiter.

The next three commands allow normalizing information to be transferred between the 2090 and the RS-232 channel. Normalizing data contains voltage and time information. This information is ASCII only. Any Nn command will clear the Normalizing set count.

NØ - Standard Numbers — When the NIC-2082 is outputting, the original normalizing is sent out and during input the data is placed in both the original and the numbers reset locations.

N1 - Original Numbers — This command sets up for transfer only with the original normalizing location.

N2 - Reset Numbers — This command sets up for transfer only with the numbers reset normalizing location.

EØ - CR/LF — This command causes all data, normalizing and termination information transferred to have a carriage return and line feed as a delimiter.

E1 - CR — This command causes all data, normalizing and termination information transferred to have a carriage return as a delimiter.

E2 - CR/LF — Same as EØ, except in D-mode CR/LF after the last data point is transferred.

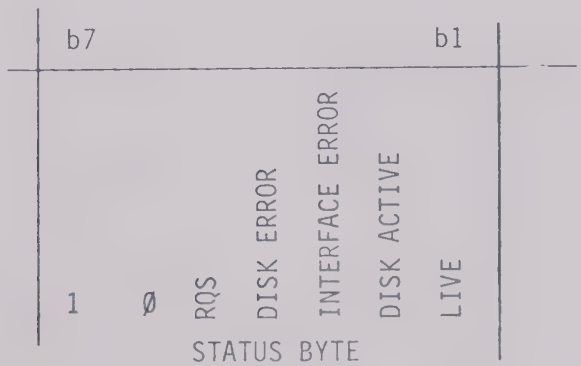
E3 - CR — As E1, except in D-mode CR after the last data point transferred.

Innnn — Set up for input of data or normalizing to NIC-2082 with a transfer count of nnnn.

Onnnn — Set up for output of data or normalizing from NIC-2082 with a transfer count of nnnn.

TERMINATION

After the completion of an operation the NIC-2082 sends out two ASCII characters, a "|", a status character and a delimiter. This status byte is a printable ASCII character in the range of "@" to "_". After the characters are sent out the NIC-2082 enables the terminal's printer and stops transferring information on the RS-232 channel until it receives an SOH character.



Termination can occur for many reasons. Operations that cause Normal termination, i.e., termination with the interface error bit equal to zero, are shown below.

1. Sending in an ETX to terminate the RS-232 operation.
2. Completion of a data point or normalizing transfer. This is indicated by the I or O command transfer count going to zero.

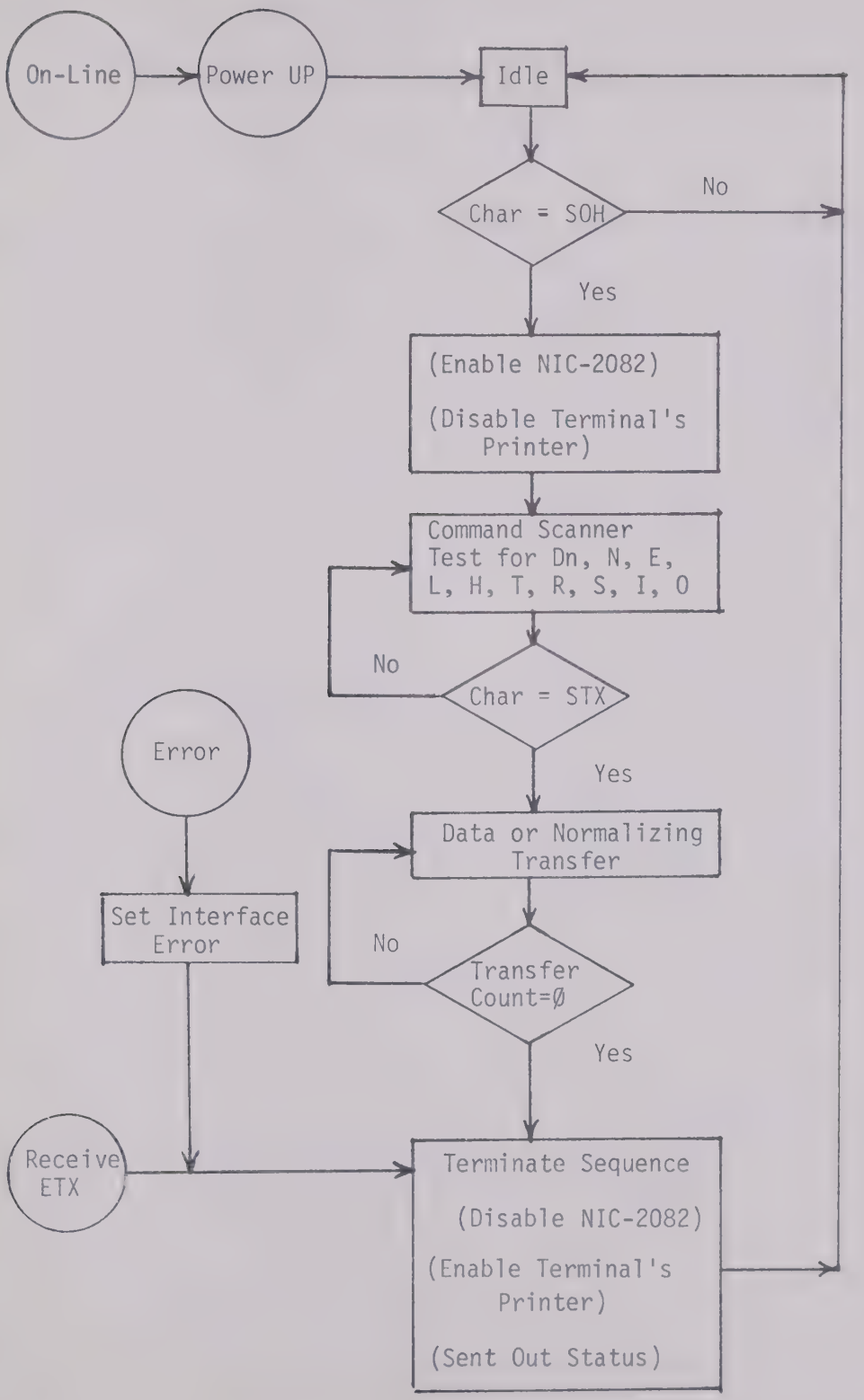
3. Completion of an operation called by the following commands, LØ, Hn, Tn, Rn and Sn.

NOTE: These operations terminate with the RQS bit set in the status byte.

Error termination can occur for the following reasons.

1. If the disk memory is active the following commands will cause an error terminate LØ, Hn, Tn.
2. If the disk memory is active and the plug-in is live the following commands will cause an error terminate Rn, Sn, I, O, STX.
3. If an operation is started with LØ, Hn, Tn, Rn and Sn and another character is sent in, except ETX, the operation will be error-terminated.
4. Sending in a delimiter that does not match the En command will cause an error-termination.
5. Receiving a character with a parity error will cause an error-termination.

OPERATION FLOW CHART - 2082



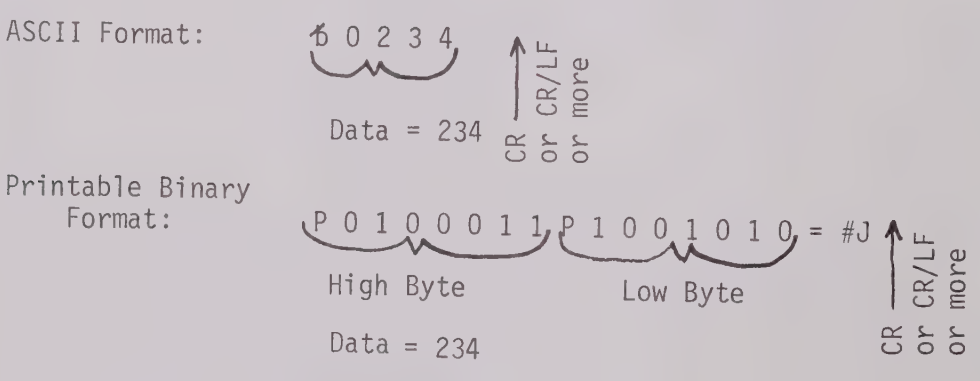
FORMAT

The characters listed below will be the information transferred on the RS-232 channel using the 7-bit ASCII code. The 8th bit transferred is parity. It can be set to even, odd, or 1.

Waveform Data Points:

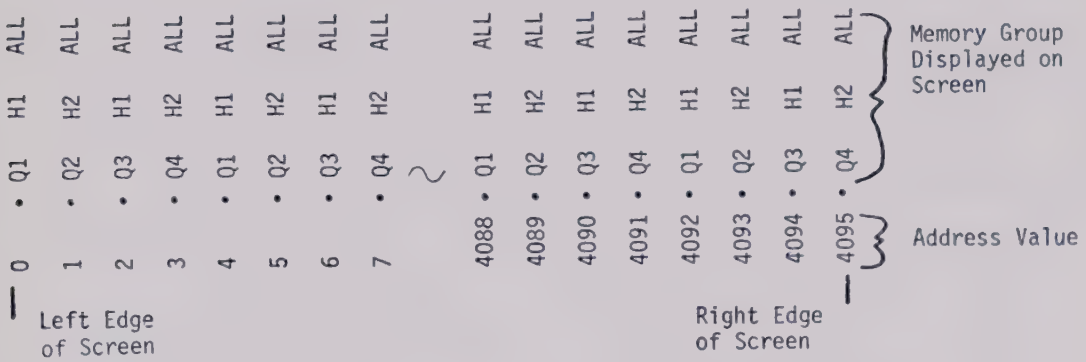
Waveform data points and data point addresses have a range of -2048 to 2047 and 0 to 4095, respectively. The top of the oscilloscope screen is 2047 and the bottom is -2048. The left of the screen is Ø.

This means that it takes 5 ASCII characters for the DØ and D1 mode to transfer one data point or to send in an address. The format must not use a decimal point. The binary modes, D2 and D3, transfer data using two printable ASCII characters as a 12-bit word. The ASCII characters for the binary mode are generated in the following way. The 12-bit word, that represents the data point value or the data point address, is split into two 6-bit bytes. Thirty two is added to both bytes. This translates the binary byte into the printable ASCII range. This procedure is reversed to convert back to 12-bit binary. The high order byte is transferred first.



If the load address mode is used, i.e., D1 or D3, any data point can be accessed and in any order. The address of a data point is proportional to the time at which the data point was measured.

OSCILLOSCOPE SCREEN WITH ADDRESS VALUES SHOWN



The memory address counter is designed so only the displayed memory group can be accessed for data transfer. If a non-displayed memory group is addressed, the counterpart in the displayed group will be transferred. For example, if H1 is addressed and H2 is displayed, the data points of H2 will be transferred or if Q1 is addressed and H2 is displayed, the data points of Q2 will be transferred.

Normalizing:

This information is transferred in ASCII format only. There are seven items in each normalizing set, "N-set". These items are, in order, V-norm bit, H-norm bit, memory fraction, V-zero, H-zero, V-norm, and H-norm.

V-norm bit indicates that the voltage values are normalized if it is a 1 and not normalized if it is a Ø.

H-norm bit indicates that the time values are normalized if it is a 1 and not normalized if it is a Ø.

The memory fraction has a value of 1, 2, 4 or 8. The memory fraction is the memory address increment used to obtain the next data point on a waveform. The reciprocal of the memory fraction indicates the amount of memory used for the waveform at the time of measurement. A single channel "ALL" measurement is 4096 data points, memory fraction equals 1. A two channel "H1" measurement is 1024 data points per waveform, memory fraction equals 4. Therefore the reciprocal of the memory fraction times 4096 equals the amount of data points on a waveform.

V-zero is the location of zero voltage with respect to the center of the screen and ranges from -2048 to 2047. For example, if V-zero equals -2048 the zero volts is at the very bottom of the oscilloscope screen and all voltages indicated on the screen will be positive.

H-zero is the address location for time zero with respect to the left edge of the oscilloscope screen. For example, if cursor trigger is used and the cursor is an address 1ØØ, during the measurement. The values for time, shown on the screen, will be negative for addresses Ø to 99 and positive for addresses 101 to 4095.

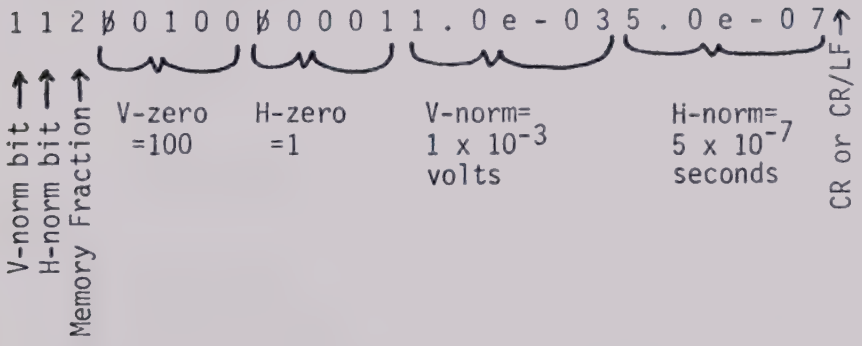
NOTE: V-zero and H-zero can be set by the scope operator using the "Numbers Reset" feature of the 2090 and using the "N2" command on the NIC-2082.

V-norm is a floating point number that shows the voltage between each level on the screen. If the data point value (-2048 to 2047) is multipled by V-norm the result will be the actual voltage at that data point. If V-norm is multiplied by 2000 the result will be the voltage range setting for that waveform.

H-norm is a floating point number that shows the time between each data point. It also equals the time per point setting.

NOTE: H-norm and V-norm range from 10^{-8} to 10^{+2} with multipliers of 1.0, 2.0 and 5.0.

Example of a normalizing set



The number of normalizing sets, N-sets, is shown below

Memory	N-set Count
ALL	8
Halves	4
Quarters	2

There are 8 N-sets in ALL Memory to account for a maximum number of 8 waveforms which would be obtained by making 4 two-channel measurements in all four quarters. If a single channel measurement is done in ALL only one N-set need be read, but all 8 must be put back into the 2090 even though they are all the same.

Before normalizing is transferred, a normalizing command must be sent, i.e., NØ, N1, or N2. This action resets the N-set counter. No more than the N-set count should be transferred or the normalizing will be incorrect. i.e., the I or O transfer count is never greater than the N-set count.

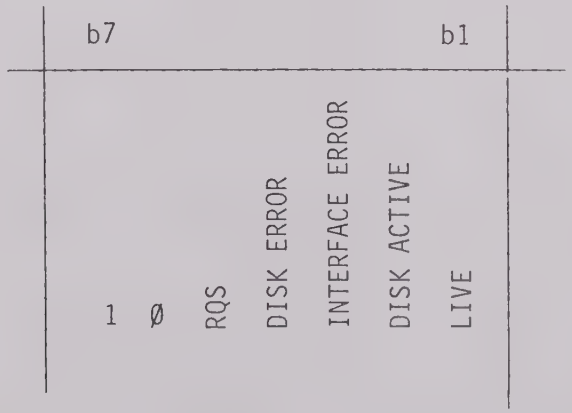
When normalizing is sent into the 2090 a normalizing set can be skipped by sending in a CR or CR/LF.

Status Byte

The status byte is sent out automatically during a termination sequence. It can also be requested by sending in a D4 or D5 command. The status byte is a printable ASCII character in the range of "@" to "_". If the RQS bit is on, a one, the previous completed operaton was either LØ, Hn, T, Rn, or Sn.

If the interface error bit is on the operation in progress was terminated prematurely due to an error.

Disk error, Disk Active and Live bits indicate the actual state of the respective LED's on the front panel of the 2090. These bits show the status of the 2090 at the time of character transmission.



STATUS BYTE

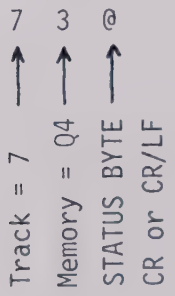
2090 Status - "D5".

This information is sent out to indicate disk memory track and the position of the "MEMORY" switch.

Memory Switch Number	Memory Switch Position
0	Q1
1	Q2
2	Q3
3	Q4
4	1H
5	2H
6	ALL
7	Open Switch

If the 2090 does not have a magnetic disk memory the track number will be 8.

"D5" output example:



I/O-Indicator - I/O ACTIVE led on the right bay front panel

The I/O - indicator has two functions.

1. When the power is first applied to the 2090 the I/O ACTIVE led flashes on and then off in 0.2 sec. If the I/O ACTIVE led remains on during power up the NIC-2082 is inoperative and if the I/O ACTIVE led continues to flash on and off the external NIC-2082 circuit board is not attached to the 2082.
2. The I/O ACTIVE led also indicates when the NIC-2082 is active on the RS-232 channel. When the NIC-2082 is deactivated, with an ETX or automatically, the I/O ACTIVE led will be off. When the I/O ACTIVE led is on the terminal printer plugged into the 2082 is disabled.

ON-LINE Switch

The ON-LINE switch service two purposes. Its first use is to activate the data terminal ready signal, i.e., it tells the modem or computer that the NIC-2082 is "on-line". This switch is ORed with the terminal "on-line" signal. This means the terminal can be on-line and the NIC-2082 can be off-line or vice-versa. With the terminal on-line and the NIC-2082 off-line even an SOH will not enable NIC-2082 operations. The second use of the ON-LINE switch is as a power-up reset. If the on-line switch is cycled from off to on, it is the same as turning the power off and on.

NIC-2082 Operation Suggestions

If data transfers are done with the magnetic disk memory it is best to rotate the disk mode switch all the way CCW to MAIN FRAME CONTROLLED and the MEMORY switch to ALL. This way the whole track is accessible to the RS-232 channel. For example, if Q1 is to be modified using the RS-232 channel, recall the track, use D1 or D3 to address only Q1 and then store the track.

NOTE: Even when the NIC-2082 is active the terminal keyboard is still enabled. This is to allow for a transmission break to be executed with the terminal break key.

The transfer count is given below for different modes of transfer.

Mode	Transfer Count
DØ or D2	tfr count = data point count
D1 or D3	tfr count = 2X (data point count) one for the data point address and the other for the data point
D2 or D3	tfr count = 1 to load a start address for the advance address mode.
NØ, 1, 2	tfr count = N set count

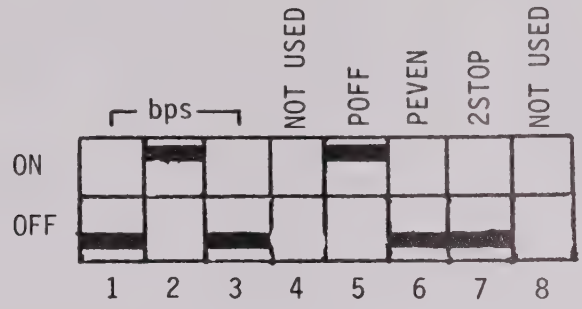
Operating Restrictions

There is only one operating restriction and that is on the NO, N1, N2 modes of 2400, 4800, and 9600 bps. When inputting norm-sets at these three speeds a wait state must be added after each N-set. The delimiter is part of the N-set. The wait state-time is listed below:

NO Wait State	N1, N2 Wait State	bps
10 ms	4 ms	9600
10 ms	2 ms	4800
20 ms	(not needed)	2400

RS-232 Configuration Switch

The switch shown below is at factory preset which is 300 bps, parity marking, and 1-stop bit.



Black bar indicates switch depressed.

Switch Number

4 & 8 Not Used

5 PARITY OFF. With this switch on the parity bit will always be a 1, i.e., Marking.

6 PARITY EVEN. If POFF = off and this switch is on then the parity bit will be even parity. If POFF = off and this switch is off the parity bit is odd parity.

7 2 STOP. With this switch on there are 2 stop bits and with this off there is 1 stop bit.

1, 2, 3 Bit Per Seconds. The table below shows the bit rate for the RS-232 channel.

1	2	3	Bit Rate
0	0	0	110
0	0	1	150
0	1	0	300
0	1	1	600
1	0	0	1200
1	0	1	2400
1	1	0	4800
1	1	1	9600

1 = On
0 = Off

Sample Programs

A. Fastest transfer of 4096 data points

1. Output

1:	SOH	Activate NIC-2082 interface and disable terminal's printer
2:	E2D3D2	Set delimiter to CR/LF after last data point. Set address to left edge of screen. Set auto advance address and printable binary mode.
3:	04Ø96	Output from the 2090 display memory 4096 data point. MEMORY switch should be in ALL.
4:	STX	Initiate output operation.

NIC-2082 sends 2 characters per data point in printable binary format.

After the last character a CR/LF is sent out.

5:	Read Two Characters	The NIC-2082 sends out a "|", a status character, which should be an "@" sign in normal operation and a delimiter. The NIC-2082 disables itself and enables the terminal's printer.

2. The following program will transfer data from the 2090 to the computer. The computer can then send the data back.

1:	SOH	Activates NIC-2082 interface and disable terminals printer.
2:	E2D1DO	Set CR/LF at end of transmission, to save time, clear the address counter and set to ASCII Auto Advance mode.

3:	O4Ø96	Output 4096 data words to the computer. if the MEMORY switch is in ALL.
4:	STX	Activates output transfer

(At this point the computer should be storing the data into a file)

5:	Read 2 Characters	See Program 1 Step 5.
6:	SOH	Same as 1:
7:	D1DO	Same as 2:, but the E2 was already set, need not be sent again.
8:	I4096	Input 4096 data words from the computer.
9:	STX	Activates transfer. At this point the computer should send out the 4096 data words that were just stored. The data can be divided by 2 before sending in order that a difference in the display can be seen.
10:	Read 2 characters.	
11:	Program complete.	

3. This program will be the same as #1, except ASCII. Load Address mode will be used.

1:	SOH	Activate NIC-2082 interface and disable terminal's printer.
2:	E2D1	Set CR/LF at end of transmission and set to ASCII Load Address mode.
3:	O8192	Output 4096 data words to computer, 4096 words of address inputted by computer, if MEMORY in ALL.

4:	STX	Activates output transfer. The computer will now send out the address, beginning with 0. An address word is sent out by the computer, then a data word is read by the computer and stored. This continues for 4096 words of data.
5:	Read 2 Characters	See program 1 Step 5:
6:	SOH	Same as 1:
7:	I8192	Same as 3: except the Input mode, 4096 words of address and 4096 words of data.
8:	STX	Same as 4: This time the computer outputs the data alternately. Divide data by 2.
9:	Read 2 Characters	
10:	Program Complete	

4. This sample section of a program shows how to load a starting address, then continuing using Auto Address.

1:	SOH	Activate NIC-2082.
2:	E2D1	CR/LF at end, ASCII Load Address.
3:	IØØØ1	Receive 1 character, the address.
4:	STX	Send out address by computer.
5:	Read 2 Characters	See program 1 Step 5:
6:	SOH	Same as 0:
7:	DO	Set ASCII Auto Advance.
8:	Ixxxx or Oxxxx	Input or output data.
9:	STX	Start transmission.

5: This sample program shows how to receive and transmit Normalization. Assume that ALL memory and 2 channels was used.

1:	SOH	Activate NIC-2082.
2:	N1	Set Original Numbers Normalizing.
3:	OØØØ2	Output two words to computer. The first N-Set being channel 1 and the second channel 2.
4:	STX	Start transmission. Store the 2 N-Sets into the computer.
5:	Read 2 Characters	See program 1 Step 5:
6:	SOH	Same as 1:
7:	N1	Resets address to start.
8:	IØØØ8	Input 8 N-Sets.
9:	STX	Start inputting N-Sets to 2082 by the computer, alternating between the channel 1 and channel 2 N-Sets stored previously, 4 times each, for a total of 8 N-sets.
10:	Read 2 Characters	
11:	Program done.	

The above examples show how to do some of the kinds of transfers available. If using the Binary mode, replace the examples for ASCII with the Binary D opcodes. It must be remembered that 2 bytes (printable characters) will be transmitted for each data word. The I and O opcodes must not be doubled when using binary mode, i.e., OØØØ1 means output one word, 2 bytes, of data. I and O must be doubled if Load Address is used.

USING A PRINTER TO CONTROL THE 2082

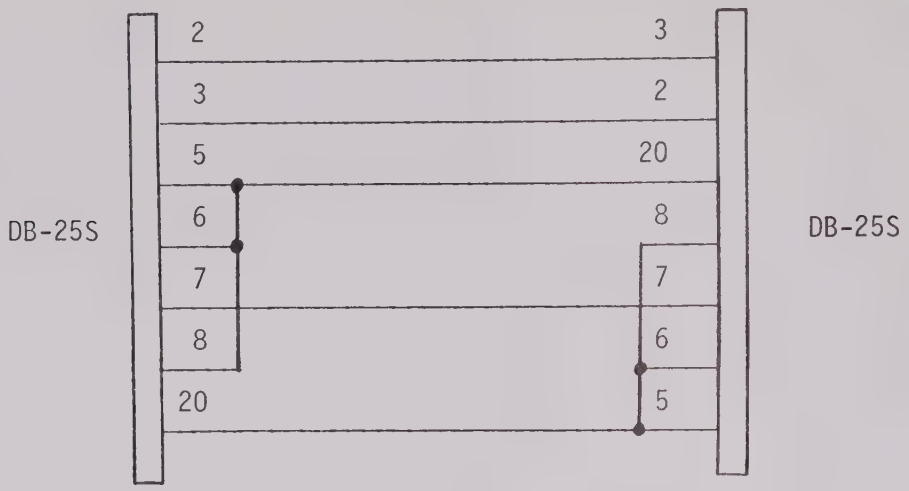
The TO MODEM port on the 2082 is used to communicate with a computer using RS-232C. The connection can be through a modem or directly to the computer. The computer is made to "think" that it is communicating with a terminal. But, a computer must still communicate with a terminal in order for the operator to enter control information to the computer and also to be able to "call up" the required programs necessary to transfer data between the 2090 and the computer. The TO TERMINAL port is used so that the computer can still communicate with the terminal. Connecting the terminal to the 2082 and the 2082 to the modem is like connecting the terminal directly to the modem, the only difference is that there is a 2082 in the communication chain.

A printer connected to the TO TERMINAL port can only communicate with the computer, when the computer is connected to the TO MODEM port. This allows the computer to send data to either the printer or the 2082. Selection of the printer or the 2082 is controlled by the SOH and ETX ASCII characters. (See pages 1 & 2).

In order to operate the 2082 with a terminal instead of a computer, a male to male adapter cable must be built.

The printer is then plugged into the TO MODEM port using the adapter cable. The Special Control Characters (Pages 1 & 2) and the Mode Control Characters (Pages 2 through 4) are typed on the printer's keyboard to control the 2082.

Shown below is the wiring of an adapter cable:



NIC-2085N INTERFACE

I. Description

The Nicolet 2085N option allows exchange of data between the Nicolet 2090-3A or 3C and the Hewlett-Packard 9825A, 9835 and 9845 desk top computers. Data can be transferred using different methods which include high speed, one word at a time, addressed or auto addressing.

II. Desk Top Computer Requirements

The minimum requirement for the HP-9825A is the HP-98212A Plotter - General I/O ROM. This does not allow transferring all of the 2090-3 memory into the HP-9825A. In order to transfer all of the 2090-3 memory and using high speed transfers, the following are required on the HP-9825A: Option 001, 8192 bytes of memory (15036 bytes total); 98210A, String-Advanced Programming ROM; 98213A, General I/O-Extended I/O ROM.

The System 35 (9835A or B) minimum requirement is the 98332A General I/O ROM.

The System 45 (9845A or B) minimum requirement is the 09845-65518 and 09845-65519 I/O ROMS.

III. Operation

This test assumes a 98032A select code of 4. Examples use the HP-9825A language, unless noted. In the examples the HP-9825A assignment operator is shown as a right bracket. An example is 0]A.

A. Addressing Modes

1. Advance Address

This mode is activated with a **wtc 4,34,** command. When this command is executed the I/O address count is set to zero. The first data point transferred will be located at the left edge of the 2090 display screen. After each transfer the I/O address counter is advanced to the next data point shown on the display screen.

2. Load Address

This mode is activated with, **wtc 4,34;wtc 4,35,** commands. When these commands are executed the first data sent to the 2085N will be interpreted as a memory address and the second as a data point. This pattern is continued until the data transfer is complete.

When the address is sent from the computer to the 2090, the address must be multiplied by 2; **wtb 4,2A.**

Write Control (wtc) Table

wtc 4, value	2085N
35	load address
34	advance address
33	plug-in "Live"
32	plug-in "Hold Next"
0	idle

Load Address Value Table

Memory Group	Start Address	Address Increment	End Address
ALL	-2048	1	2047
H1	-2048	2	2046
H2	-2047	2	2047
Q1	-2048	4	2044
Q2	-2047	4	2045
Q3	-2046	4	2046
Q4	-2045	4	2047

When the data transfers are complete a **wtc 4,0** should be executed to tell the 2090 that the I/O operation is finished. This action also extinguishes the I/O ACTIVE LED. If the unit is a 2090-3C, the floppy disk will not operate unless the I/O ACTIVE LED is off.

B. Read Status

This allows the computer to check the status of the plug-in, i.e., to "see" if it is in "Live" or "Hold" and also to check the status of the disk, i.e., to "see" if it is doing an operation. The following table shows the values received when a **rds(4)** is done in the 9825A.

rds(4) value	Plug-In 'Live"	Disk "Active"
288	no	no
289	yes	no
32	no	yes
33	yes	yes

C. Data Format

Data and normalization are transferred together as one word. The 2090 12-bit data word is the top 15 bits of the 98032A. The top 4 bits of the 98032A are the 2090 sign bit. The 2090 normalization bit is the LSB of the 98032A.

When data only is needed, the data word placed into the calculator must be divided by 2. This procedure gets rid of the normalization bit; **int(.5rdb(4))}D**.

2090 - 98032A Format Table

	MSB															LSB
98032A Data Bits	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
2090 Data Bits	11	11	11	11	10	9	8	7	6	5	4	3	2	1	0	N

N = Normalization bit

D. Normalization

Before reading further, read the following section of this manual:

DIGITAL I/O; Section C.3; DATA, ADDRESS & NORMALIZATION FORMAT, Normalization; pages VII-7 through VII-14

A good understanding of the above section of the manual will help in the understanding of what follows.

A note of caution at this point. Whenever data is read from the 2090, it must be placed back into the 2090 with normalizing. The data may be changed to reflect a mathematical result. If the normalization is not placed back in the 2090 correctly, erroneous results may appear on the 2090 time and voltage readout. Various sample programs will follow that show how to operate with the normalization.

In order to operate with normalizing on the HP-9825A, the General I/O-Extended I/O ROM must be installed. The **shf** (shift) and **rot** (rotate) functions are used, which are obtained from the Extended I/O ROM command subset.

1. Normalization Read

The normalization is read in as you would read in data. The normalization bit must be stripped off the data word. Different ways of doing this are:

```
shf(shf(rbd(4),-15),15)
rdb(4)mod2
shf(shf(itf(X$[I,I+1]),-15),15)
```

Example a) shifts out the 15 data bits. The **rbd(4)** brings in the data from the 2090.

Example b) uses the remainder of a divide to get the normalization bit.

Example c) is like a), but the data were brought in previously using the buffered I/O. Buffered I/O is explained later in the samples.

After the normalization bit is extracted it must be placed somewhere in order to build up the complete array of normalization N-Sets. A good place is to store the N-sets into an array. In this example and other examples the array **B[2,4,8]** will be used. The array is defined as follows:

first variable - (X will be used in this position)

1 - Original normalization.

2 - Reset numbers normalization.

second variable (Y will be used in this position)

1 - HNORM; Horizontal normalization.

2 - VNORM; Vertical normalization. Value is in volts per level, not the range value indicated on the switch.

3 - HZERO; Binary value of where trigger occurred or the value of the Horizontal cursor position when Reset Numbers was executed.

4 - VZERO; Binary value of where the voltage baseline is or the value of the Vertical cursor position when Reset Numbers was executed.

third variable (Z will be used in this position)

This number indicates which N-Set is being used. The maximum number of N-Sets is 8. The minimum number of N-Sets needed is 1.

The following is an example of how to transfer normalization from the 2090 to the HP-9825A.

```
0: fxd 0;wtc 4,34;wtc 4,35;0}A;dim B[2,4,8]
1: for X=1 to 2;for Y=1 to 4;for B=1 to 16;for Z=1 to 8
2: wtb 4,2A;ior(shf(rdb(4),-15),B[X,Y,Z])}B[X,Y,Z];A+1}A
3: if B#16;rot(B[X,Y,Z],1)}B[X,Y,Z]
4: if B=16;if Y=3 or Y=4;shf(shf(B[X,Y,Z],-4),4)}B[X,Y,Z]
5: if B=16;if Y=3 or Y=4;if B[X,Y,Z]>2047;-4096+B[X,Y,Z]}B[X,Y,Z]
6: next Z;next B;next Y;next X;wtc 4,0
*24907
```

Program Comments:

Line 0 - Sets fixed format, dimensions the B array, enables the 2090 load address transfer mode and the beginning address for normalization transfer.

Line 1 - Sets the for/next loops in order to transfer the norm bit into the array. Variable B is used to keep track of which bit of a N-Set is being transferred.

2 - Writes the address (A) to the 2090. Reads the data from the 2090, gets shifted so that the norm bit is in the sign bit position. This procedure allows building up of the norm N-Set. As each bit is shifted into place, it is inclusive ORed with the corresponding N-Set. The address in incremented by 1.

3 - If the last bit of the N-Set has not been read, shift the N-Set so that the next N-Set bit may be added.

4 - If the last bit of the N-Set has been transferred and the N-Set is HZERO or VZERO, shift out the top four bits to eliminate any false bits that may arrive from the 2090. False norm bits do not affect the 2090.

5 - If the last bit of the N-Set has been transferred and the N-Set is HZERO or VZERO and the N-Set is greater than 2047, add -4096 to the N-Set to correct for the sign bit to make the N-Set into a two's complement number.

6 - Do the next N-Set, do the next bit, do the next N-Set type, do Reset numbers next. When done, reset the 2085N and turn off the I/O ACTIVE LED.

When this program is completed, the array will contain all the possible N-Sets. But the values in the array variable Y= 1 or 2 will be a binary encoded equivalent of HNORM and VNORM.

The binary values must be converted to a floating point value that the computer can use to calculate time and voltage values from the data that are read. For this another array is created. The new array will be N[2,3,8]. The array is defined as follows: (X, Y & Z will be used here also.)

first variable

1 - Original normalization

2 - Reset numbers normalization

second variable

1 - HNORM

2 - VNORM

3 - Memory fraction

third variable

Number of the N-Set being used.

Another value that must be converted from the binary value in the B array is the memory fraction. The N array is similar to the B array, so that easy conversion from one array to another is possible. The only exception is the memory fraction. But for conversion, Y in the B array is always 1 and Y in the N array is always 3.

The following is an example of how to convert the B array into the N array:

```
0: dim N[2,3,8]
1: for X=1 to 2;for Y=1 to 2;for Z=1 to 8
2: shf(shf(B[X,Y,Z],-6),12)}B;int(B/4)-Bmod4}P;2^P}M
3: shf(shf(B[X,Y,Z],-10),10)}D
4: Mtn^(-3int(D/16)+int(Dmod16/4)-Dmod4)}N[X,Y,Z]
5: if B[X,Y,Z]<0;0}N[X,Y,Z]
6: next Z;next Y;next X
7: for X=1 to 2;for Z=1 to 8;2^shf(shf(B[X,1,Z],-4),14)}N[X,3,Z]
8: next Z;next X
*27124
```

Program comments:

Line 0 - Dimension the N array

1 - Set up for/next loops.

2 - Shifts the array that the N9, N8, N7, N6 bits are in the 4 LSBs. N9, N8 has N7, N6 subtracted from it so that a power is left over. Two is raised to the power (P) to create the multiplier (M). The mod (modulus) command is used to get the remainder portion of a division.

3 - Shifts the array so that the N5, N4, N3, N2, N1, N0 bits are in the 6 LSBs. The shifted result is placed in the register called "decade" (D).

4 - This line takes -3 times the binary value of N5, N4; adds the value of N3, N2 then subtracts the value of N1, N0. Integer (int) and modulus (mod) are used instead of shifting as less programming is required to obtain the results. A careful study of the N positioning and this program line will show how the 3 binary values are obtained. M is then raised to the power of ten using the result computed earlier in this line. That total result is placed into the N array. The value in the N array is now an understandable number which can be used by the computer.

5 - If the binary value of HNORM or VNORM is less than 0, the value for H or VNORM was not normalized in the 2090. A 0 is placed into the N array to indicate a not normalized value.

6 - Next set of values.

7 - Set for/next loop to convert the memory fraction value. N11, N10 is shifted so that the bits are in the 2 LSBs. Since the binary value of N11, N10 is only the power of 2, 2 is raised to the shifted value to get the memory fraction value.

8 - Next set of values.

2. Using the Normalization with Data

After the normalization arrays are built from the raw normalization bits, they can be used with the data to tabulate actual time and voltage values instead of binary values.

Since there can be 8 different N-Sets, it must be determined which N-Set to use with a particular data point. Under normal operating conditions, the selection process is simple. If ALL of memory, single channel, is being used, only one N-Set has to be used. All 8 N-Sets will be the same. If 2 channel ALL was used, only 2 N-Sets are used; i.e., N-Set #1 and 2. But it is possible to get a N-Set configuration that may not make any sense. This possibility arises when different sections of memory were updated when a larger memory was used initially and a smaller unit of memory was used for new data. The memory address is used for determining which N-Set to use for a particular data point.

If data are read into the computer and that data value is operated on immediately and that result is sent to a logging device (printer, etc.) an address scheme of 0 through 4095

can be used to determine the time value of the data point and can be used to determine which N-Set to use.

The time value is determined by taking the data point location, dividing it by 8 then add 1 to the remainder result, i.e., `Amod8+1}Z`. A is the address value and Z will be the N-Set variable. The HNORM value is now located in `N[X,1,Z]`. The X variable will be 1 or 2 depending on if you want the Original or Reset Numbers normalization values. Now that the HNORM value has been located, it is multiplied by the integer of the address divided by the memory fraction. The memory fraction is located in `N[X,3,Z]`. The time number is now equal to this equation:

```
N[X,1,Z](int(A/N[X,3,Z]))
N[X,1,Amod8+1](int(A/N[X,3,Amod8+1]))
```

The voltage can now be determined as the Z value has already been determined. The read data point is now multiplied by the VNORM value which is located in the array value `N[X,2,Z]`. The data value can be computed with the following equation.

```
N[X,2,Z](int(.5rdb(4)))
N[X,2,Amod8+1](int(.5rdb(4)))
```

If all of the 2090 memory is to be stored in the computer, it is suggested (especially for the HP-9825A) that the data be stored in integer form. Examples of storing integer data are shown later. To determine the address time value of an integer value, use the following equation: (I = for/next loop register value).

`int((I-1)/2)}A` (A will equal 0 through 4095)

When 1H or 2H memory is used, the 0 to 4095 addressing scheme is still used, but instead of incrementing each point by 1, increment by 2. If Q1, Q2, Q3 or Q4 are used, increment by 4.

3. Normalization Write

When data are read from the 2090 and later written back into the 2090, the normalization must be written as well or unpredictable results will be obtained on the 2090 time and voltage display.

If the data were stored into the computer and care was used so that the normalization bit of each data word was not lost, the data in the stored file can be written back to the 2090 without any problems. When the data in the file are operated on and the results are placed back in the same or a different file, it would be a good practice to keep the normalization bit for that particular data word intact.

If the normalization bit was lost, the normalization arrays must be structured for regenerating the normalization bit. If the B array was left intact, the only conversion needed is to make the top 4 bits of HZERO and VZERO equal to 0. That is accomplished using the following program:

```
0: for X=1 to 2;for Y=3 to 4;for Z=1 to 8
1: shf(shf(B[X,Y,Z],-4),4)}B[X,Y,Z]
2: next Z;next Y;next X
*1925
```

Program comments:

Line 0 - Set up for/next loop for HZERO and VZERO.

1 - Shift out the top 4 bits.

2 - Next word of array.

If the B array was damaged or changed so that the values for HNORM and VNORM are no longer valid, or if user values of H or VNORM are needed, the B array must be reconstructed. The N array is used for this prupose. The floating point numbers in the N array must be converted into the binary form that is used by the 2090. The following program is used to do the conversion.

```
0: dim W$[10]
1: for X=1 to 2;for Y=1 to 2;for Z=1 to 8;flt 1;str(N[X,Y,Z])}W$;fxd 0
2: if N[X,Y,Z]=0;-1}B[X,Y,Z];gto "next"
3: val(W$[1,4])}M;val(W$[6,8])}E;if M>2;.1M}M;E+1}E
4: log(M)/log(2)}P;0}B[X,Y,Z];if Y=1;1024(log(N[X,3,Z])/log(2))}B[X,Y,Z]
5: if P=1;256+B[X,Y,Z]}B[X,Y,Z]
6: if P#1;64abs(P)+B[X,Y,Z]}B[X,Y,Z]
7: if E>0;4E+B[X,Y,Z]}B[X,Y,Z]
8: if E<0;16int(abs(E)/3)+abs(E)mod3+B[X,Y,Z]}B[X,Y,Z]
9: "next":next Z;next Y;next X
*19976
```

Program comments:

Line 0 - Dimensions W$ for use later.

1 - Sets up for/next loop. Stringing the N array into W$ allows the easy retrieval of the digits of the floating points number.

2 - If the N array is equal to 0, a non-normalized value was obtained. Placing -1 into the B array sets the not normalized bits of the word so that the 2090 will not normalize the display for this N-Set. Also skips the rest of the conversion.

3 - The multiplier is placed in M. The exponent is placed in E. If M is greater than 2, divide M by 10 and add 1 to E. M must be .5, 1 or 2 only.

4 - Turn M into a Power (P) of 2 for 2090 use. Clear out the B array. If HNORM is being converted, change the memory fraction into a power of 2 and place the result in bits N11 and N10. This result could have been shifted, but the multiplication by 1024 has the same result.

5 - If the power equals 1, add 256 (N8) to the B array.

6 - If the power is other than one, add 64 times the absolute value of P (N7, N6) to the B array.

7 - If the exponent is greater than 0, add 4 times E (N3, N2) to the B array.

8 - If the exponent is less than 0, add the following results to the B array: 16 times the integer of the absolute of E divided by 3 (N5, N4); the remainder of the absoluite value of E divided by 3 (N1, N0).

9 - Next set of values to be converted.

Once the B array has been converted, the data and normalization can be written into the 2090. If the data have already been written into the 2090, the following program shows how to add the normalization bits to that data:

```
0: wtc 4,34;wtc 4,35;0}A
1: for X=1 to 2;for Y=1 to 4;for B=-15 to 0;for Z=1 to 8;wtb 4,2A
2: shf(shf(rdb(4),1),-1)+shf(shf(B[X,Y,Z],B),15)}D;wtb 4,2A;wtb 4,D
3: A+1}A;next Z;next B;next Y;next X;wtc 4,0
*26192
```

Program comments:

Line 0 - Sets to load address mode and initializes the address register with the start address of normalization.

1 - Sets up for/next loops to transfer the N-Set bits. B will be used to keep track of which bit is being sent and how much shifting is required to get that bit. The address is also written to the 2090.

2 - The data are read from the 2090, the old normalization bit is shifted out and that result is added to the new shifted bit of normalization. The new normalization bit is shifted into the LSB with the other 15 bits equal to 0. The result is placed in the data register (D). The address is re-sent to the 2090, then the data with the new normaling are written to the 2090.

4 - The address is incremented. The next N-Set bit is sent out. When completed, the I/O ACTIVE LED is turned off.

E. Data Without Normalization

If the data are to be used without the normalization, the data are read using the following program statement:

```
int(.5rdb(4))
```

If the data are to be written into the 2090 without normalization, the following program statement would be used:

```
wtb 4,2D
```

where D = data word

When the above program statement is used, the 2090 will display 1 second per point and 1 volt per level (2000 v. range). Time 0 will be in the center of the screen.

If a program was written using the read-alter-write technique the normalization bit can set a flag which is used later to reconstruct the normalization. Shown below is a method of using read-alter-write:

```
0: cfg 0;rdb(4)}D;if Dmod2=1;sfg 0
1: int(.5D)}D;int(.1D)}D
2: wtb 4,2D+flg0
*5966
```

The above example divides the data (D) by 1/10.

F. Sample Programs For HP-9825A

The sample programs shown below assume a 98032A select code of 4 and a Memory Group of "ALL".

1. This program shows how to store all 4096 data points in the calculator using a string variable as a fast read/write buffer. This program also can be used to record waveforms on tape or load them from the tape cartridge back into the 2090. To transfer the waveform to the calculator press "RUN". The waveform is now in the string variable Y$ and it can be recorded on tape. Press the ERASE pushbutton on the 2090 and then press "CONTINUE" on the calculator. This step brings back a stored waveform from the calculator.

To load a waveform from the tape cartridge into the 2090-3, press "RUN" and then load the string variable, Y$, with the data points from the tape. Then press "CONTINUE" and the recorded waveform will appear on the screen of the 2090-3.

Enter the following program into the 9825A:

```
0: dim Y$[8208]
1: buf "data",Y$,2
2: eir 4,34
3: tfr 4,"data",4096
4: wtc 4,0;stp
5: eir 4,34
6: tfr "data",4,4096
7: wtc 4,0;end
*19497
```

Program comments:

This section reads the data from the 2090-3.

Line 0 - Dimension a string variable, Y$, for 8208 bytes. This is for 4096 16-bit words plus 16 bytes of overhead for the fast read/write buffer.

1 - Allocate a buffer called "data" which has also been dimensioned as a string variable, Y$. The 2 stands for the type of buffer, i.e., a fast read/write buffer with a data format of 16-bit words.

2 - Activate advance address mode. "eir" is used instead of "wtc" because the "tfr" statement will reset the "wtc" to zero.

3 - Transfer 4096 data points from the I/O card with select code 4 to a buffer called "data".

4 - Set idle mode for 2085N and stop program.

This section writes the data into the 2090-3 when "CONTINUE" is pressed.

5 - Activate advance address mode.

6 - Transfer 4096 data points from a buffer called "data" to an I/O card with select code 4.

7 - Set idle mode for 2085 and end program.

2. This program stores all 4096 data points and has the same features as program "1", listed above, but this program uses the binary read and write statements for data transfer.

Enter the following program into the 9825A:

```
0: dim X$[8192]
1: wtc 4,34
2: for I=1 to 8192 by 2
3: rdb(4)}N
4: fti (N)}X$[I,I+1]
5: next I
6: wtc 4,0;stp
7: wtc 4,34
8: for I=1 to 8192 by 2
9: wtb 4,itf(X$[I,I+1])
10: next I
11: wtc 4,0;end
*29623
```

Program comments:

This section reads the data from the 2090-3.

Line 0 - Dimension X$

1 - Set advance address mode.

2 - Set up a for/next loop for 4096 data points read a data point from 2090-3 into N.

3 - Read the binary data from I/O card 4 to register N.

4 - Convert the number in N from full precision to integer precision and store the two-byte number in the string X$, at locations I and I + 1.

5 - End of the for/next loop.

6 - Set 2085N to idle and stop program.

This section writes the data into the 2090-3 when "CONTINUE" is pressed.

7 - Set advance address mode.

8 - Set up for/next loop.

9 - Convert the integer stored in the string X$, at the location I and I + 1 back to full precision. Write that data point into the 2090-3.

10 - End of the for/next loop.

11 - Set 2085N to idle and end program.

3. This program divides the waveform in Q3 by 2. It also shows how to use the load address mode.

Enter the following program into the 9825A:

```
0: wtc 4,34;wtc 4,35
1: for I=-2046 to 2047 by 4
2: wtb 4,2I
3: cfg 0;rdb(4)}D;if Dmod2=1;sfg 0
4: wtb 4,2I;int(.5D)}D
5: wtb 4,2int(.5D)+flg0
6: next I
7: wtc 4,0;end
*29388
```

Program comments:

Line 0 - Set load address mode.

1 - Set up for/next loop so I will only address Q3.

2 - Write address to 2085N.

3 - Read data point from 2085N and sfd 0 if norm bit = 1.

4 - Write address to 2085N and get rid of norm bit,

5 - Multiply data point by ½ and write the result into 2085N. The norm bit is added to the result.

6 - End of for/next loop.

7 - Set 2085N to idle and end program.

G. Test Programs for HP-9825A

1. The following is a program that reads the normalization, prints the N-Sets on a printer and then sends the normalization back to the 2090. A select code of 2 is used for the printer. A printer is required to run this program.

After the program listing is an example of the printout.

```
0: wti 0,2;wti 6,1;wtc 2,1;wtb 2,39;wtc 2,0
1: dim W$[10],B[2,4,8],N[2,3,8]
2: "*****This section reads the Normalization":
3: fxd 0;wtc 4,34;wtc 4,35;0}A
4: for X=1 to 2;for Y=1 to 4;for B=1 to 16;for Z=1 to 8
5: wtb 4,2A;ior(shf(rdb(4),-15),B[X,Y,Z])}B[X,Y,Z];A+1}A
6: if B#16;rot(B[X,Y,Z],1)}B[X,Y,Z]
7: if B=16;if Y=3 or Y=4;shf(shf(B[X,Y,Z],-4),4)}B[X,Y,Z]
8: if B=16;if Y=3 or Y=4;if B[X,Y,Z]>2047;-4096+B[X,Y,Z]}B[X,Y,Z]
9: next Z;next B;next Y;next X;wtc 4,0
10: "*****This sections converts the binary normalization":
11: "*****  to floating points numbers":
12: for X=1 to 2;for Y=1 to 2;for Z=1 to 8
13: shf(shf(B[X,Y,Z],-6),12)}B;int(B/4)-Bmod4}P;2^P}M
14: shf(shf(B[X,Y,Z],-10),10)}D
15: Mtn^(-3int(D/16)+int(Dmod16/4)-Dmod4)}N[X,Y,Z]
16: if B[X,Y,Z]<0;0}N[X,Y,Z]
17: next Z;next Y;next X
18: for X=1 to 2;for Z=1 to 8;2^shf(shf(B[X,1,Z],-4),14)}N[X,3,Z]
19: next Z;next X
20: "*****This section prints the normalization":
21: wrt 2,".....";fmt 1,5/,c50,3/;wrt 2.1,"2090 NORMALIZATION PRINTOUT"
22: wrt 2,"ORIGINAL NUMBERS";wrt 2;-2048}A
23: for X=1 to 2;cll 'Heading'
24: for Z=1 to 8;fmt 3,c7,c10,z;fmt 4,c16,c18,z;fmt 5,3c7
25: wrt 2.3,str(A),str(Z);flt 1
26: wrt 2.4,str(N[X,1,Z])&" s/pt",str(N[X,2,Z])&" v/level";fxd 0
27: wrt 2.5,str(B[X,3,Z]),str(B[X,4,Z]),str(N[X,3,Z])
28: A+1}A;next Z;if X=1;fmt 5,3/,c,/;wrt 2.5,"RESET NUMBERS"
29: -2048}A;next X;fmt 5,9/;wrt 2.5
30: wrt 2,"Data Address is the beginning address for data."
31: wrt 2,"If HNorm or VNorm = 0.0e 00, that Norm value was not normaliz
32: wrt 2,"Memory Fraction indicates how much to add to the address."
33: wrt 2,"  The next address must have the same Memory Fraction"
34: wrt 2,"  or incorrect data will result.";wrt 2
35: "*****This section clears the normalization in the 2090":
36: wtc 4,34;wtc 4,35;for A=0 to 1023;wtb 4,2A
37: shf(shf(rdb(4),1),-1)+1}N;wtb 4,2A;wtb 4,N;next A;wtc 4,0
38: "*****This section computes the norm N-Sets":
39: for X=1 to 2;for Y=1 to 2;for Z=1 to 8;flt 1;str(N[X,Y,Z])}W$;fxd 0
40: if N[X,Y,Z]=0;-1}B[X,Y,Z];gto "next"
```

```
41: val(W$[1,4])}M;val(W$[6,8])}E;if M>2;.1M}M;E+1}E
42: log(M)/log(2)}P;0}B[X,Y,Z];if Y=1;1024(log(N[X,3,Z])/log(2))}B[X,Y,Z]
43: if P=1;256+B[X,Y,Z]}B[X,Y,Z]
44: if P#1;64abs(P)+B[X,Y,Z]}B[X,Y,Z]
45: if E>0;4E+B[X,Y,Z]}B[X,Y,Z]
46: if E<0;16int(abs(E)/3)+abs(E)mod3+B[X,Y,Z]}B[X,Y,Z]
47: "next":next Z;next Y;next X
48: for X=1 to 2;for Y=3 to 4;for Z=1 to 8
49: shf(shf(B[X,Y,Z],-4),4)}B[X,Y,Z]
50: next Z;next Y;next X
51: "*****This section writes the normalizing":
52: wtc 4,34;wtc 4,35;0}A
53: for X=1 to 2;for Y=1 to 4;for B=-15 to 0;for Z=1 to 8;wtb 4,2A
54: shf(shf(rdb(4),1),-1)+shf(shf(B[X,Y,Z],B),15)}D;wtb 4,2A;wtb 4,D
55: A+1}A;next Z;next B;next Y;next X;wtc 4,0
56: dsp "********* PROGRAM DONE *********";end
57: "Heading":fmt 2,c,c7,c11,c17,c11,c7,c10
58: wrt 2.2,"Data Address","N-Set","HNorm","VNorm","HZero","VZero","Fraction"
59: ret
*24912
```

A copy of this program may be obtained from NICOLET. See the section, Obtaining Test Programs for the HP-9825A.

2090 NORMALIZATION PRINTOUT

ORIGINAL NUMBERS

Data Address	N-Set	HNorm	VNorm	HZero	VZero	Fraction
-2048	1	5.0e-07 s/pt	5.0e-05 v/level	-2048	0	8
-2047	2	1.0e-06 s/pt	1.0e-04 v/level	-1231	0	8
-2046	3	2.0e-06 s/pt	2.0e-04 v/level	-150	0	8
-2045	4	5.0e-06 s/pt	5.0e-04 v/level	755	0	8
-2044	5	5.0e-07 s/pt	1.0e-03 v/level	-2048	0	8
-2043	6	1.0e-06 s/pt	2.0e-03 v/level	-1231	0	8
-2042	7	2.0e-06 s/pt	5.0e-03 v/level	-150	0	8
-2041	8	5.0e-06 s/pt	1.0e-02 v/level	755	0	8

RESET NUMBERS

Data Address	N-Set	HNorm	VNorm	HZero	VZero	Fraction
-2048	1	5.0e-07 s/pt	5.0e-05 v/level	-888	319	8
-2047	2	1.0e-06 s/pt	1.0e-04 v/level	-55	319	8
-2046	3	2.0e-06 s/pt	2.0e-04 v/level	878	319	8
-2045	4	5.0e-06 s/pt	5.0e-04 v/level	1319	319	8
-2044	5	5.0e-07 s/pt	1.0e-03 v/level	-888	319	8
-2043	6	1.0e-06 s/pt	2.0e-03 v/level	-55	319	8
-2042	7	2.0e-06 s/pt	5.0e-03 v/level	878	319	8
-2041	8	5.0e-06 s/pt	1.0e-02 v/level	1319	319	8

Data Address is the beginning address for data.
If HNorm or VNorm = 0.0e 00, that Norm value was not normalized.
Memory Fraction indicates how much to add to the address.
  The next address must have the same Memory Fraction
  or incorrect data will result.

2. The following program can be used to test the 2090-3 and the 2085N. This program will write a 4K ramp into the 2090-3, then read it back to see if it was stored correctly or if there are any bit errors. If any bit errors appear, it will print which bit is in error, then it will continually write the 4K ramp so that the bad bit may be found and corrected. If no errors are found, the program will stop.

Enter the following program into the 9825A:

```
0: dim E$[13]
1: fxd 0;dsp "NIC-2085N READ/WRITE TEST"
2: cfg 3;wtc 4,34;for I=-2048 to 2047;2I}D;if Imod2;D+1}D
3: wtb 4,D;next I
4: wtc 4,34;0}E
5: for I=-2048 to 2047;rdb(4)}J;band(J,8191)}J;2I}D;if Imod2;D+1}D
6: band(D,8191)}K;if K#J;ior(eor(J,K),E)}E
7: next I;if E#0;sfg 3
8: for I=12 to 0 by -1
9: if E>=2^I;E-2^I}E;"1"}E$[abs(I-13),abs(I-13)];jmp 2
10: "0"}E$[abs(I-13),abs(I-13)]
11: next I;prt "BAD BITS ARE 1","","11","109876543210N";spc 1
12: prt E$;spc 3;if not flg3;wtc 4,0;end
13: wtc 4,34;for I=-2048 to 2047;2I}D;if Imod2;D+1}D
14: wtb 4,D;next I;jmp -1
*4035
```

H. Obtaining Test Programs for the HP-9825A.

A copy of the test programs for the HP-9825A and the NIC-2085N will be copied free of charge if a blank HP-9825A data tape is sent to:

NICOLET INSTRUMENT CORPORATION
MANUFACTURING ENGINEERING MANAGER
OSCILLOSCOPE DIVISION
5225-2 VERONA ROAD
MADISON, WI 53711

NICOLET INSTRUMENT CORPORATION

5225 Verona Road Madison, Wisconsin 53711 608/271-3333